PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

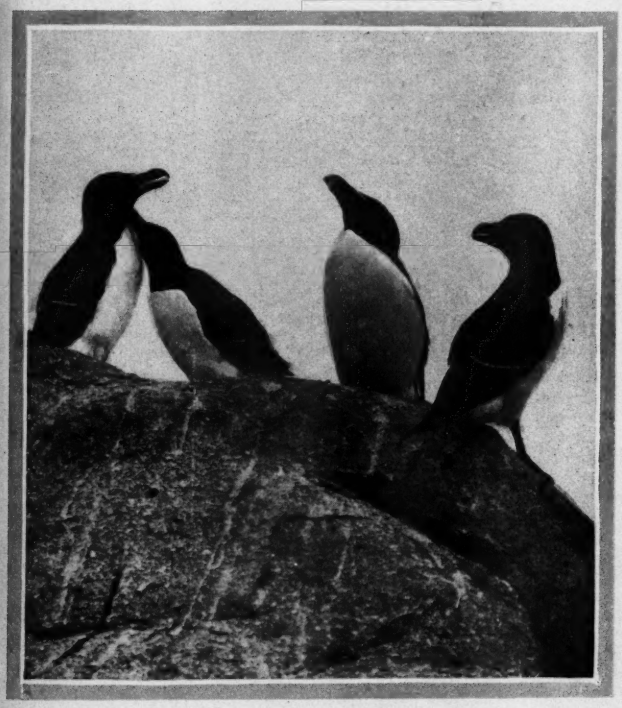
JUL 15 1925

TUBERCULOSIS : THE QUESTION OF ITS CURE.

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VI. No. 67. JULY, 1925 (Annual Subscription 12s.6d. Post Free). PRICE 1s. NET



SEASIDE VISITORS.

CONTENTS

	Pages.
Editorial Notes	237
Tuberculosis and the Question of Its Cure	239
Sex at Choice	246
Drift, the Fish Controller ...	248
Photomicrography	252
The Value of Change	257
The British Association for the Advancement of Science ...	258
The Stoney Indians of the Bow River, Alberta, Canada ...	259
The Cave-Dwellers of Creswell Crags	265
The Death-watch and Furniture Beetle	270
Telepathy and Clairvoyance ...	273
Book Reviews	274

DRUGS AND SURGICAL REQUISITES (No. 6 DEPT.)

Drugs, Dispensing, Surgical Instruments, Medicine and First-Aid Cases and Invalid Specialities.
The Drugs are of the best quality and Prescriptions are compounded by qualified chemists.
Estimates for Drugs, etc., supplied on application, and the latest price lists forwarded.

SURGICAL FITTING ROOMS.
Special rooms for taking measurements and fitting elastic goods, trusses, and other surgical appliances are attached to the department.
Experienced assistants are employed for attending on ladies requiring elastic stockings, belts and other surgical requisites.

HONORARY MEMBERSHIP
of the Society can be obtained upon application to the Secretary.

ARMY & NAVY
CO-OPERATIVE SOCIETY LIMITED
105 VICTORIA STREET WESTMINSTER LONDON, S.W.1

PSYCHE

JULY, 1925

Edited by C. K. OGDEN

Prof. EMILE BOUTROUX:
Good Sense

Prof. F. PAULHAN:
The Cognitive Value of Emotion

Prof. H. PIERON:
Visual Reception

BERTRAND RUSSELL, F.R.S.
Is the Universe Finite?

SANTE DE SANCTIS:
Sublimation and Conversion

L. A. REID:
Some Aspects of Expression

S. THALBITZER:
Emotion and Insanity

KEGAN PAUL,
Broadway House, Carter Lane, E.C.4.

STANDARD TEXTBOOKS

WHERE TO SEEK FOR SCIENTIFIC FACTS.
By ALEX. B. EASON, M.A., A.M.I.E.E. Of direct use to scientists, engineers and students. 8vo, **1s. 2d.**

HANDY ELECTRICAL DICTIONARY.
By W. L. WEBER. Defines over 4,800 distinct words, terms and phrases. Vest pocket size, **1s. 8d.**

***THE PRACTICAL ELECTRICIAN'S POCKET BOOK.**
An invaluable work of reference, which is officially recommended by the City and Guilds Authorities and by all the electrical journals. 578 pp. **3s. 4d.**

GROWING CROPS AND PLANTS BY ELECTRICITY
By E. C. DUDGEON. A useful and interesting work, explaining what has been done on a practical scale. Cl. 8vo, illustrated, **1s. 8d.**

COMPENDIUM OF APPLIED ELECTRICITY
By PAUL E. LOWE. Vest pocket size, 342 pp., 214 illustrations. **2s. 2d.**

EXPERIMENTS WITH THE SLIDE-WIRE BRIDGE.
By DAVID ROBERTSON, B.Sc., M.I.E.E. Cr. 4to, profusely illustrated, **3s. 3d.**

***ELEMENTARY DETERMINANTS FOR ELECTRICAL ENGINEERS.**
By H. P. FEW. A simple explanation of the application of Determinants to Electrical Testing, Telegraphy, Telephony, Power Distribution, etc. Cl. 8vo, **4s. 3d.**

ELECTRIC VEHICLE HANDBOOK
By H. C. CUSHING, Jun. The only work of its class on the market. Cr. 8vo., 388 pp., 180 figs. **8s.**

POPULAR FALLACIES, explained and corrected.
By A. S. E. ACKERMAN, B.Sc. One of the most interesting books in the English language. Its 980 pages contain a vast amount of information on all kinds of subjects which are likely to appeal to readers of *Discovery*. **13s.**

All post free at prices stated. Ask for catalogue D9.

Books marked * are recommended by the City and Guilds Authorities.

S. RENTELL & CO., LTD.

36, Maiden Lane
LONDON, W.C.2

Phone "GERRARD 2460."

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VI. No. 67. JULY, 1925. PRICE 1s. NET

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Prof. R. S. Conway, Litt.D., F.B.A.

Edited by Hugh B. C. Pollard.

Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: 8 Bouverie Street, London, E.C.4.

Telephone: City 9852 (6 lines).

Telegrams: Benbrolish, Fleet.

Annual Subscription, 12*s.* 6*d.* post free anywhere in the world; Single numbers, 1*s.* net; postage, 2*d.*

Binding cases for Vol. V, 1924, are now ready. Price 2*s.* 6*d.* net each; postage, 6*d.*

Editorial Notes.

The British Association for the Advancement of Science meets this year at Southampton. There must be many readers of Discovery who are not members of the B.A. Yet it is the type of person who reads Discovery who is the ideal member for the B.A. It is perhaps worth while re-stating with emphasis that the British Association is primarily not a closed body of distinguished scientists, but essentially an open organization welcoming to its membership not only scientific workers but others interested in all departments of science. The cost of an annual subscription, plus the reports which are a record of the important lectures delivered, is thirty shillings. It can be recommended as one of the best intellectual investments. The yield quoted in terms of sheer interest shows a remarkably high return, and there is always the chance that one or more of the lectures remain as a mental landmark. This is the speculative side. There is always the chance that one may quite casually be present at some lecture where the first announcement of a new great theory may be made. Somebody whose name at present means little outside a small academic circle may turn out to be a Darwin or a Pasteur. Apart from the really serious side of the meeting, there is the very pleasant party or excursion side. The irreverent person who alluded to it as a "scientific beanfeast" may have been pert in his choice of words, but was not altogether wrong in his facts. There must be a number of rather shy people who would really enjoy the meeting and profit enormously from it, but who do not quite know how to get into touch with the Association. Others may believe that a scientific qualification is a necessary preliminary.—Not so. The average reader of Discovery is just the particular class of public who should be a member of the British Association. It is the interest in science not the qualification that matters. There are no formalities about membership, simply write to the Secretary at Burlington House and join.

* * * * *

Last month Discovery was sold out within a week of publication. We had not a copy left in the place, and good money was being turned away from the counter. Naturally, well-earned successes of this nature do not affect the permanent subscriber, but they do disappoint the casual reader and ourselves. We should like everybody who wants a copy to have one, but if we do not have a preliminary warning of sudden incalculable demands we cannot be expected to print an extra thousand copies on chance. The moral is: be an annual subscriber either direct or through your newsagent; then you can be sure of your copy. There are no means by which we can tell what particular article will create a special demand. A casual survey of the demand for back numbers during the last year shows that for some reason or other people have wanted back numbers of nearly every issue. Sometimes they refer in their letter to the particular article desired, more often they only give the month. Sometimes odd letters reach us which ask for a number with "the article about so-and-so." They give neither title nor author's name, and it is not always easy to make out which it is. Anyway we do our best, for often these letters come from the ends of the earth. We ask again, as we have asked in the past, for more subscribers. Pioneer work of any kind is difficult and expensive, and we

are slowly but successfully building up this journal with the help of our readers. Every subscription helps and allows us to increase our margin.

* * * * *

The disturbances in China seem remote to most of us, yet they are interfering with quite a promising number of scientific ventures. China is one of the fields which has not been worked out. Biological and archaeological material of the most absorbing interest is known to exist, and even the great mammals are not necessarily all known. Somewhere in China there are believed to be blue tigers. No European has ever seen one, but so far as can be gathered they are something like a big chinchilla cat. We do not know whether they are legendary creatures like the dragon or as real as the okapi or the dwarf hippo, but there is enough evidence to support the possibility of their existence to interest the leading zoologists of the Far East. For a year or two I have been hoping that we should hear that a blue tiger had been secured. Once there came to me from China a much battered parcel containing a rag tiger—a native child's toy—but blue. It had been bought at a market in some town of the interior within a hundred or so miles of the reputed blue tiger country. It is still the only blue tiger in captivity. I had hoped that it was an omen of good import, but the last mail brings a letter saying: "If only the country would settle down there would be a marvellous field of research opened out for workers, and we could keep armies of them busy for many years to come. The country everywhere is in such a state of turmoil, due to wars, bandits, etc., etc., that it is almost impossible to work except in a few isolated areas, and even then under very hazardous conditions. In spite of this, however, I have secured some very interesting things of late, amongst others one of the peculiar giant salamanders, *megalobatrachus japonicus*, and the very remarkable beaked sturgeons of the Yangtze River and also the little Yangtze alligator. The extraordinary interest of these lies in the fact that their only living relations in the world to-day occur in the Mississippi Basin and adjacent parts of the United States." This is the kind of letter which makes one out of patience with turmoil and bandits. Here are the real mysteries of China, the puzzles about fauna and flora, the missing bits of the jigsaw puzzle scientific workers are labouring to put together before we can get to clear ideas about the history of the world. Your sensational novelist, writing of China, would have you believe in a variety of occult miracles, lamas with odd hypnotic powers and a medley of glamorous balderdash. But how easy it is to write of the inexplicable which never really happened when you compare this with the really difficult task of puzzling out why on earth the heltbender, or giant salamander, whose courtesy title is *cryptobranchus allegheniensis*, finds his only living cousin in the Yangtze River of China, and that, incidentally, the same relationship exists in the flora of the two areas. I admit that it is not the ideal theme for a sensational novel, but on the other hand it is a first-class mystery. Ice-bridge, Wegener theory of continental masses, here is infinite room for discussion. A lot more pieces of the jigsaw puzzle must be fitted in first, but given time a solution of the problem will be found.

* * * * *

Have you heard and seen the atom? If not, may I remind you that you can do so at no charge to yourself if you visit the Royal Society's demonstration in the Government Building at Wembley. Incidentally, you cannot yet see the atom itself, but you can see the visible record of its track, the smoke trail of a tiny rocket. The scientific staff are prepared to demonstrate every known kind of ray and wave. The visible spectrum, the ultra-violet and the infra-red can all be made manifest at your bidding. Light can be translated into sound and wireless waves can be made to show themselves in an exquisite dancing pattern of intricate weaving curves on the top of a cathode valve, a fairy ballet of the frequencies. The whole exhibit is a marvel of thoroughness and beautifully demonstrated, and it does not matter in the least if you do not really know all about it before you go. They explain what they are doing and what the particular experiment demonstrates, and you can ask questions and have it all painstakingly explained. It is really a very wonderful chance, for there you may see an actual demonstration of the latest wonders of science, things you may have read about but never had a chance to see actually working. Do not miss it, for if you do you will have lost an opportunity of seeing something which you will remember for all your days. It is probably the most wonderful scientific show that has ever been made available to an intelligent public. If there was a charge for admission there would probably be long queues waiting outside. As it is, it is a free exhibition, and that possibly makes people suspicious. Still, go and see it for it alone is worth the pilgrimage to Wembley. If you do not see the wave band you want, ask for it; they have the widest range in the world in stock.

Tuberculosis and the Question of Its Cure

By S. Lyle Cummins, C.B., C.M.G., M.D.

David Davies Professor of Tuberculosis, Welsh National School of Medicine, Cardiff; Principal Medical Officer, Welsh National Memorial Association.

There is so much confusion about tuberculosis that this article is of the very greatest importance. It gives a clear authoritative summary of how far science has gone toward dealing with the disease and indicates the trend of the latest research. Many people connected with sufferers from the disease will benefit from this article, for it explains the reason of modern sanatorium treatment and the great need for care when the patient is restored to normal environment.

In these latter days medical problems have come to occupy an increasing amount of space in lay newspapers and journals, so much so that one is constrained to believe that questions of disease and its prevention and cure make good copy. This development of journalism is neither unnatural nor unwarrantable. The grouping together of human beings into teeming urban communities which is incidental to industrial development entails, on the one hand, facilities for the spread of infection and, on the other, a competitive rise in education and the standards of living. The result is that infective diseases tend to be facilitated in their distribution from man to man and an increasing proportion of the population possesses the intelligence and leisure to be interested in its ailments. At the same time the general diffusion of information on medical subjects has dangers as well as advantages, because members of the lay public, though profoundly touched by medical problems, cannot often bring to their study the critical knowledge which would enable them to distinguish the probably false from the possibly true. And it will be obvious, too, that the wider-spread the malady under discussion and the more tragic and personal its effects, the more serious will be this gullibility of a public anxious for information on a subject of individual as well as general interest.

Doubtful Claims.

Perhaps there is no disease to which these remarks are so applicable as tuberculosis. Only doctors and nurses who witness the mental and moral struggles of those who fear that they themselves or their loved ones may be infected can realize the significance for the general public of such a heading as "A New Cure for Tuberculosis." None except those intimately associated with patients suffering from this disease can appreciate the touching self-denial, the long-drawn-out economies which wives or mothers will endure to provide the often costly "new remedy" for the sufferer in the family circle; nor without special knowledge can anyone fully appreciate the tragedy of disappointment and despair when, as usually happens, the new treatment turns out to be useless.

The Press, for some years past, has been inundated with highly-coloured reports about one new remedy after another, together with pointed references to the lethargy of government departments or the medical profession in not placing at the disposal of every sufferer the benefits of what some sub-editor believes to be a certain cure. For this reason it is, perhaps, an opportune moment to raise, in a journal like *Discovery*, the question of the curability of tuberculosis and as to how far there is a reasonable hope of extending or improving our methods in the treatment of this disease.

Medicines.

It is to be feared that not only in the minds of the general public, but to some extent even in the minds of the medical profession itself, a great deal of confusion exists as to the influence of medication on disease. Even to-day a considerable number of people would appear to believe that there exists for every disease some drug or combination of drugs which may be described as "curative." In the eyes of a section of the general public a doctor's skill is thought to consist in knowing the medicine or combination of medicines which may be relied on to lead to "cure" in any given disease. If the patient does not get well, the assumption is that the doctor does not know the right remedy and, worse still, if the patient recovers the doctor often gets the credit of having wrought a "cure."

A definite but diminishing number of medical men tend to encourage this idea by allowing their patients to believe that the medicines which they prescribe are "curative."

It is time that the general public realized that, with a very few exceptions, medicines are powerless to cure and, at best, are calculated to alleviate the symptoms of disease.

(*Photo by Mr. L. Crouch*
A group of girl patients under treatment by graded work and graded rest at the North Wales Sanatorium at Llangwyfam, Denbighshire.

While favourable results may sometimes follow symptomatic treatment in acute diseases which tend to lead either to death or to spontaneous recovery in the course of a few weeks, it is merely ridiculous to expect permanent benefit from them in diseases such as tuberculosis, which endure as chronic bacterial processes within the tissues for years. Here the alleviation of symptoms may have a momentary importance by producing rest, a feeling of well-being and even, in some cases, a prolongation of life; but they cannot rank as "cures" and the more active preparations are inapplicable owing to the danger of producing a "drug habit." It is safe to say that in the case of tuberculosis symptomatic treatment can never be curative.

To be a "cure" for tuberculosis a remedy must either enhance the natural powers of resistance to such an extent that the germs of the disease can no longer survive in the body or must itself be capable of killing the germs without seriously injuring the tissues.

When a new "cure" for tuberculosis is advertised in the Press or elsewhere, its advocates ought to be asked and should be prepared to answer the following questions:—

1. Is it alleged to cure by raising the bodily resistance? or
2. Is it alleged to cure by a directly destructive action on the germs? and, if so
3. Is it harmless to the tissues and cells of the human body?

When these points have been cleared up it remains to decide by carefully controlled observations whether the claim can be substantiated in a way to satisfy the critical mind of the scientist.

Tests.

It may be said at once that this decision is by no means easy to arrive at and that tests must be made by independent groups of trained investigators working in the fullest knowledge of the nature of the alleged remedy; the findings of each group confirming or extending the findings of the others.

If this much is admitted—and it can hardly be denied—then it follows that no remedy, the nature of which is not fully disclosed, can be evaluated by scientific methods. Frankness is the acid test of sincerity. *No "secret remedy" deserves a moment's consideration by the Press, the public, or the medical profession. In the first place, the mere fact of "secrecy" convicts its advocates of ulterior motives. In the second, it cannot be adequately standardized or accurately tested by independent workers without a full knowledge of its nature.*

This statement, which is of fundamental importance, may appear pedantic to the general reader. "Surely," he may say, "this is an exaggeration and the testing of a 'cure' must be a comparatively simple matter. You try a remedy on a certain number of cases, and if the majority of those treated get well and those untreated die, then it is clear that the remedy is curative. Why should anyone worry about what is *in* it provided the results speak for themselves?"

If only the question could be reduced to these two simple factors of rapid recovery or speedy death, all our difficulties would be removed—and, perhaps, some of our "remedies" as well! But the problems of disease refuse to simplify themselves to this extent even in the most acute and fatal maladies; and least of all in the long-drawn and insidious infection caused by the tubercle bacillus.

Under the heading "tuberculosis" are included patients of almost every description: some unaware of the nature of their illness and going on with their ordinary vocations without medical advice; others wrongly diagnosed as suffering from coughs, chronic

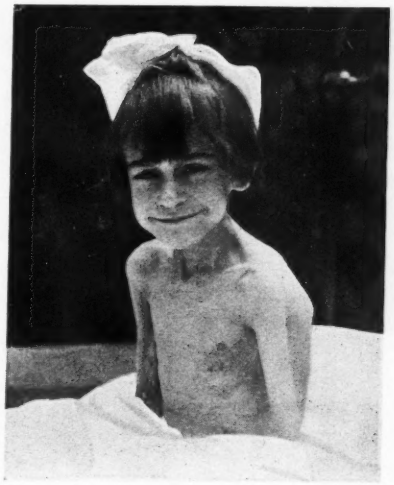
colds, recurrent influenzas or simple pleurisies for which "bottles" have been duly prescribed—sometimes ill, sometimes well and regarding themselves as delicate rather than diseased. Then, again, there are tuberculous patients who have been correctly diagnosed and who are yet able to participate in sports and pastimes and to carry on the ordinary business of life with suitable intervals of rest during exacerbations of their symptoms; and finally, there are the advanced cases often full of the unfounded optimism which is known to all doctors as the "Spes Phthisica," ready at any time to believe that they are improving, and especially likely to believe this when some new nostrum is given to them for the first time.

A Duel.

Tuberculous disease is the end-result of a long-continued and long-unrecognized infection. Ninety per cent of us harbour the germs without knowing it and without suffering for it. One or two per cent of us reach the stage at which the infection culminates in actual disease. About one person in every thousand in these islands dies of the disease every year. Every diagnosed case goes through his ups and downs—sometimes improving to the extent of feeling quite well, sometimes failing, only to pick up again after rest or treatment—the majority gradually descending in the scale of ill-health; while a few, in whom the disease becomes arrested, appear to be completely restored; and a few put up no fight at all and die rapidly.

(Photo by Mr. L. Crouch

This child, although with such a fine appearance of health and well-being, was suffering from an acute form of pulmonary tuberculosis which lead to her death after a year in hospital.



(Photo by Mr. L. Crouch

A child patient with typically phthisical appearance. She lived happily and hopefully in hospital from early in 1921 till August 1924, when she died as the result of acute spread of the disease in the sounder lung.

One thing, however, is perfectly sure—that the majority of the patients will be hopeful and only too ready to believe that the latest treatment is doing them good.

The state of the tuberculous patient at any given moment represents the resultant between the infective activities of the germ and the curative endeavours of the body under the stimulus of infection. The balance between these two factors is expressed by endless permutations and combinations of sickness and health. Nothing is more deceptive than the appearance and condition of these patients—a point which is well brought out in the photographs which illustrate this paper.

Misleading Appearances.

Clinical type varies enormously with age, and yet even in children the sharpest contrasts may sometimes be seen. The little misery whose pathetic appearance is so well illustrated in one of the photographs was thought to be within a few weeks of death when she entered hospital early in 1921, but she lived on as a patient until August, 1924, while the pretty and bright child in the companion photograph lasted barely a year.

Perhaps these extreme variations of clinical type may serve to indicate the difficulties of deciding as to the results of treatment in a disease so protean in its manifestations as tuberculosis, more especially tuberculosis of the lungs.

This side of the question can be approached with some degree of optimism because we have indubitable evidence that Nature has provided machinery for the arrest of tuberculosis. We have only to look at the hunchback who passes us on his way to work to realize that tuberculous disease tends to spontaneous arrest.

Forms of Treatment designed to raise the Bodily Resistance.

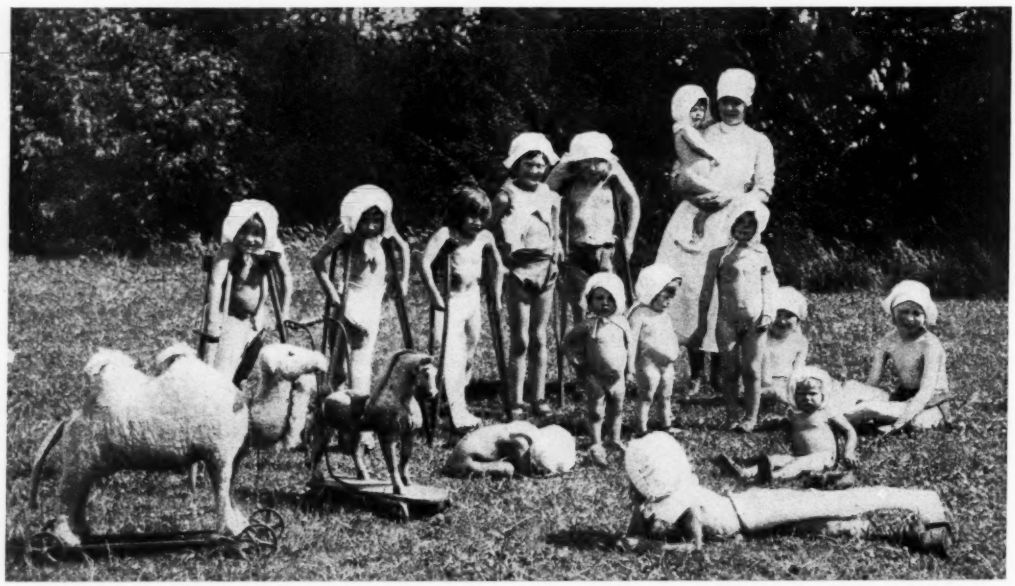
We note his twisted back and the deformity of chest and trunk which have resulted from it ; and yet he is in health and able to do his job. To the medical man his history need not be inquired into, because it is known. There was a time when the bones of his cannot be said to be cured, although his disease is arrested.

How has his recovery, such as it is, been brought about ?

We may assume that during the acute stage of his illness it was impossible for him to get about. It is probable that he lay for months or years, either at his home or at some hospital, in a state precluding anything like active movement or work.

The very nature of his illness imposed upon him rest.

There we find the supreme indication for treatment on the lines of assisting natural efforts at repair.



(*Photo by Mr. L. Crouch*

Sunlight, fresh air, and "surgical rest" of tuberculous joints are here combined in the treatment of a group of crippled children at Glanely Hospital near Cardiff, an Institution under the Welsh National Memorial Association.

vertebræ column were acutely diseased so that they crumbled and gave way—that is the explanation of his deformity—and yet Nature, while leaving the deformity, has arrested the disease. There are struts of new bone and binding strands of fibrous tissue to support and sustain the spinal column, and the infection, even though it may still exist in the depths of the injured area, is completely shut in and no longer active.

Is he cured ? It would be inaccurate to say so, although apart from his deformity he may be a fit and healthy man. A sudden shock or blow over the site of the deformity may still light up the old infection into an active state. Under these circumstances he There is a good chance that the trouble will settle down and become inactive *if rest can be assured ;* and this applies not only to tuberculosis of the bones and joints but also to tuberculosis of the lungs.

Far beyond all symptomatic treatment by one medicine or another comes this supreme physiological remedy, *rest.* All the procedures which have hitherto been found of real value in the treatment of tuberculosis have depended upon or at least included *rest.*

The organization of *rest* treatment is no haphazard process, but a deliberate prescription of the exact degree of rest which the patient requires and no more. The index which guides the physician is the constitutional condition of the patient as shown by his

temperature, his pulse, and his respiration. If the temperature rises after a short walk, the patient is forbidden short walks and, perhaps, reverted to a limited permission to sit up in the ward. Even this may be denied him if his temperature still fluctuates, and he may be sent back to bed until his temperature has settled. If, however, short walks can be tolerated, longer walks may be judiciously tried and then, perhaps, light work succeeded by heavier work; but all the time the temperature is being carefully watched and any irregularity is regarded as an indication that the limits of tolerance have been exceeded and the patient must revert to a greater degree of rest. It may even be necessary to rest the lung itself by filling the chest cavity of the affected side with air (artificial pneumothorax) or removing portions of the ribs to allow the chest wall to fall inwards on the lung (thoracoplasty).

Vital Rest.

How does rest act? It would seem that it acts by diminishing the auto-inoculations of tuberculous material which had been entering the circulation from the foci of infection at every excessive movement. If these auto-inoculations are excessive they compel the body to react too strongly and the result is raised temperature, diminished appetite, wasting, sweating and all the toxic symptoms which are so characteristic of tuberculous disease. A respite from excessive auto-inoculations gives a chance to the body to elaborate the chemical neutralizing substances upon which it depends for its defence. After a period of rest this defensive process may have been so far successful as to permit of a much greater degree of bodily activity than the patient could formerly tolerate; thus the rest may be gradually diminished and give place *to an amount of exercise or work which is such that it allows just that amount of auto-inoculation which falls short of producing toxic phenomena and suffices to excite further defensive resistance.*

A moment's consideration will show how careful must be the grading of rest and activity respectively if these processes of auto-intoxication and auto-immunization are to be adjusted to the patient's advantage.

The role of the sanatorium or hospital superintendent is one requiring extreme skill, patience, and judgment, and where such qualities are possessed in a high degree the results are found to be proportionately good.

There can be no question that sanatorium treatment, applied to suitable cases, brings about arrest of the disease. Nor can it be questioned that "absolute rest" will often bring a patient, who had been on the downward grade, into such a favourable state that sanatorium treatment by graded exercise and work becomes possible for him.

Artificial pneumothorax, thoracoplasty, and allied operations, represent a still further extension of rest treatment to the rehabilitation of tuberculous persons; while sunlight, fresh air and good food have a directly beneficial action which, as the result of recent research, is coming to be more and more appreciated. Sunlight and fresh air, together with splinting to ensure rest to affected joints, is being "administered" in one of the illustrations; another shows sanatorium treatment in progress. A modern sanatorium is almost a town in itself; a town inhabited by a population relieved of immediate responsibility and anxiety, sheltered from the struggles of competitive life and filled with the optimism which comes from seeing the steady progress of other patients under the same regime.

But there is another side to the picture. Patients leave our sanatoria with increased weight, increased health, increased capacity for work. The disease process almost appears to have come to an end. They leave the sheltered conditions of graded work, adequate food, fresh air, and careful medical supervision, to go back to homes which are often inadequate and work which is frequently trying and unsuitable or, worse still, to unemployment with its poverty, anxiety and distress. These are the conditions which favour relapse and which demonstrate all too frequently that it was "arrest" and not "cure" which had taken place.

Is there no alternative in the shape of a remedy which can be given to the patient at his home or at an out-patient department, so that he may go on with his work and get treated at the same time? Attempts to meet this need have been made on the lines of "immunization."

Tuberculin Therapy.

"Old tuberculin" and its more recent varieties have the curious property of being almost inert when injected into uninfected men or animals. When, however, they are inoculated into *infected* persons they evoke a marked and characteristic reaction. This makes them extremely valuable in diagnosis. When it comes to treatment it will be obvious that a very violent reaction may do harm, while on the other hand there is the possibility that a slight reaction may, in certain torpid forms of tuberculosis, prove beneficial.

After a long and careful study of comparable groups of cases, some treated with and some without tuberculin

at the King Edward VII Sanatorium at Midhurst, Bardswell could only draw the following conclusion :—

> " In a considerable number of cases tuberculin, so far as can be judged from immediate clinical results, has no obvious influence on the lesions. The patient is gradually made tolerant to it, but this seems to be the only objective indication of its effect. Whether this tolerance is of value is at present a matter of uncertainty. Further, in a proportion of cases, tuberculin is not merely inert ; it is definitely prejudicial."

These remarks appear to apply to all the " tuberculins," " vaccines " and " partigens " which have since been suggested. So much for " active immunization " as it is called. It is the conviction of the writer and of many others that, in well-selected patients, the steps towards natural arrest of the disease may often be aided by judicious tuberculin inoculations, using the term " tuberculin " in its most inclusive sense, but even with this much admitted most of us will subscribe to the dictum of Bardswell that " tuberculin has not proved itself to be a remedy in the ordinary sense of the term."

Nor can anything more hopeful be said for " passive immunization " in which attempts are made to render the blood of a horse or other animal " immune " to the poisons secreted by tubercle bacilli and then to inoculate this " protective " blood into human patients.

Here, too, although many of the patients appear to " do well," very few of them " get well." They are not " cured."

Forms of Treatment designed to destroy the Tubercle Bacilli.

The minute cellular organisms of disease are very similar in structure to the individual cells of the human body, and it is not surprising that chemical substances destructive to germs are very often destructive to the body cells also. Nearly all the antiseptics known to us are injurious to the tissues. Amongst the hundreds of antiseptics which destroy germs in the test-tube but few can be safely introduced into the circulation, and these for the most part only in such dilute solutions that their action upon germs is negligible. But the success attending the discovery of " salvarsan " and the half-dozen or so of preparations so powerfully germicidal as to stand the requisite dilution without loss of activity is full of promise for the future.

In the case of a disease like tuberculosis, however, there is still another factor of difficulty. We know that the cell protoplasm of the tubercle bacillus is of a highly toxic nature when brought into solution. This toxic substance is held within the meshes of a waxy and fatty framework during the life of the bacillus, but becomes capable of diffusion into the surrounding fluid when the germ disintegrates. Bearing this in mind it is not difficult to realize that any substance, no matter how harmless to the tissues in itself, which leads to the simultaneous death and disintegration of a large number of tubercle bacilli within the body, is certain to liberate poisonous substances and to be a source of danger not only to the germs but to the patient. It is obvious, too, that the larger the number of bacilli in the tissues, the greater will be the volume of poison arising from their destruction. In other words, the more advanced the disease, the greater will be the risk.

From these considerations the conclusion may be drawn : *That if ever a substance is found which is capable of destroying the germs of tuberculosis within the infected body, its use, though perhaps curative under certain conditions, will be fraught with danger* ; unless, indeed, there can be found an antidote to the liberated toxins which may be employed along with the bactericidal substance.

Is there any hope that such a substance or combination of substances is likely to become available ? Robert Koch, the discoverer of the tubercle bacillus, found that gold salts were lethal to the germ. Unfortunately, those tried by him proved to be directly harmful also to the body cells, and both he and many other workers were obliged to admit defeat in their search for a " gold cure " for tuberculosis.

More recently, however, there have been new attempts along the same lines, and it would seem that there is ground for hope.

Professor Möllgaard of Copenhagen, after testing in vain over a hundred preparations containing gold molecules in one combination or another, has at last hit on a substance, previously known to chemists but never applied in pharmacology, which he designates " Sanocrysin," and which he believes to be applicable in the treatment and, perhaps, the cure of tuberculosis.

" Sanocrysin," or sodium auro-thio-sulphate, is now being carefully tested in this country under arrangements made with its discoverer by the Medical Research Council. It may be said at once that it fulfils some of the postulates which have been indicated above as inseparable from any chemotherapeutic method of treating tuberculosis. While harmless, in the doses recommended, for healthy persons, it causes violent reactions in persons suffering from the disease ; and these reactions are found to be much more severe when the disease is far advanced. On the other

hand, in patients capable of tolerating the necessary doses, it has led to a complete disappearance of the bacilli from the sputum and a cessation of all the symptoms of the disease.

Möllgaard has gone a step further and has produced an anti-toxic serum which is designed to neutralize the poisons liberated from the disintegrated bacilli during Sanocrysin treatment, and it would appear that the use of this serum has had a certain measure of success. One thing is abundantly clear—that "Sanocrysin," owing to its danger, is not a remedy for general employment in its present form. Unless the patients are carefully selected and their treatment supervised with minute care, much harm may follow its use. But, in cases of the right type, treated under suitable conditions, the results already attained in Denmark and in this country are of great interest and justify the hope that we may be on the verge of acclaiming "a remedy in the ordinary sense of the term."

THE SCIENCE MUSEUM.

Benzene Centenary.

AMONGST the exhibits shown at the Science Museum are two original specimens of benzene, prepared and labelled by Faraday, which were bequeathed to the Museum in 1911 by H. L. Barnard, Esq.—it will be remembered that Faraday married Sarah Barnard—and an autographed photograph of himself which was bequeathed to the Museum by Miss Jane Barnard. The original cabinet in which Faraday stored the specimens of benzene and which contains many other specimens of his chemical discoveries, including the polished weldings of steel and platinum and the alloys produced with Mr. Stodart in 1821 in the search for a non-rusting steel, is also on view. Other interesting exhibits show the importance of benzene to the synthetic dye industry and illustrate the distillation of coal-tar, from which benzene is obtained on a commercial scale. A series of models of the principal space formulæ proposed for benzene, showing the arrangement of the atoms within the molecule in space, is not only instructive but emphasizes the importance with which benzene has been regarded since the time of its discovery.

LOSS OF ACIDITY IN STORED APPLES.

IT is a commonplace that the flavour of an apple is improved by keeping. Recent research shows that this is directly traceable to a gradual reduction in the apple's acidity. This decreases at first rapidly and then more slowly, until finally it alters very little over a relatively long period. In apples kept in cold storage, however, the loss of acidity is much slower. If the acidity is too great on putting them into cold storage the apples are practically certain to decompose. Hence, with some kinds, it is better to let them mature naturally for a while before placing in cold storage, a point that has its commercial aspect.

USE OF SEA POWER AT GRANGEMOUTH.

THE six lock-gates, weighing 160 tons each, at the sea entrance to the Grangemouth Docks, were recently removed, repaired and replaced with the help of the sea itself. The gates are hollow, and when in use are kept in position by being filled with sea water. To remove them this was pumped out and the gates made watertight. This was done at low tide, and at the flow they were floated off their bearings and towed to the graving dock where repairs and a general overhaul were made. To replace them they were towed back to the locks at high tide and put into position so that at the ebb they sank back on their bearings, and being filled with water will perform their normal functions until their next spring-cleaning.

DEFINITIONS OF STEEL AND CAST IRON.

TO know the proper definitions of an everyday substance is sometimes very useful in argument. The latest for steel and cast iron are given us by a Japanese chemist in the Imperial University of Tôhoku. Steel he defines as "an iron-carbon alloy with a content of carbon lying between 0·035 and 1·7 per cent." Cast iron is similarly "an iron-carbon alloy" but with a carbon content of "between 1·7 and 6·7 per cent."

CHINA'S MATCH INDUSTRY.

THE reports on industrial developments made from time to time by the United States consuls abroad provide interesting reading. From the U.S. Consul-General at Shanghai we learn that the manufacture of matches in China has gradually increased during the last ten years to such an extent that to-day China is able to produce all she requires. In the past, China has depended upon imported matches, mostly made in Japan, plus some imported from Europe. This import trade will be hard hit now that it is realised that the republic is self-supporting in this commodity.

"Sex at Choice."

By Julian Huxley.

A critical scientific review of Mrs. Monteith Erskine's book "Sex at Choice," from the modern biological point of view.

MRS. ERSKINE, undeterred by the innumerable pioneers whose theories of sex-determination have fallen by the wayside, here propounds one of her own. To be precise, it is an old theory modified in a new way. It is, at bottom, the familiar theory of Dr. Schenck, that either ovary of the human female produces ova destined to give rise to one sex only—females from the left ovary, males from the right. There are, as I have said above, various details of superstructure which Mrs. Erskine has built upon this foundation; but it will not be necessary here to enter upon a description or discussion of these, since the theory is entirely based upon this foundation, and stands and falls with it.

Modern Discoveries

Now the difference between Mrs. Erskine and most of her predecessors is this: that she does, whereas they or most of them did not, live in a time when a coherent and properly-grounded biological explanation of sex-determination had been arrived at. That theory or law is based on the work of a large number of men of science in a large number of different countries during the last quarter of a century, and is now as firmly based as are the laws of Mendel themselves—of which, indeed, it is in reality a special case. Any new theory of sex-determination, therefore, must now either demonstrate that the current biological explanation is false, or must show how a reconciliation can be effected between it, the interloper, and the present favourite; failing one or other of these, it must present such strong evidence in support of its case as to leave no doubt of its having to be reckoned with as a scientific fact.

Before we proceed to discuss whether the book before us fulfils any or all of these requirements, we had better remind our readers of the current biological view in its broad outlines.*

In the first place then, all modern workers (and with this Mrs. Erskine agrees) are unanimous in finding that the sex of higher animals is normally determined at conception—the moment when the two separate reproductive cells from father and mother unite. The difference of sex, then, must be due to differences among the reproductive cells.

In man, as well as in all other mammals on which we have evidence, the sex-determining difference exists between the male reproductive cells or sperm, whereas all the ova of the female are alike with regard to their sex-determining capacity.

This can be tested in three ways:—By observation through the microscope of the processes leading up to the formation of the reproductive cells; by measurement (again, of course, through the microscope by the aid of eyepiece micrometers) of the size of the finished article—the ripe reproductive cells themselves; and by a knowledge of a curious mode of inheritance known as "sex-linked" inheritance.

All three methods have been tested in man, and all agree. There are two classes of sperms, one slightly larger than the other. The larger contains a so-called sex-determining or X-chromosome*; the smaller does not. All the ova, however, contain an X. Furthermore, the man contains only one, the woman two such X's. We can thus symbolize the process of sex-determination thus:—

Parent	Reproductive cells	Offspring
Male: X+no-X	50% X 50% no-X	50% XX=female
Female: XX	100% X	50% X+no-X=male

In other words, the presence of one X in an individual causes it to become a male, that of two X's to become a female.

Assertions or Proof.

I must here repeat that the existence of this type of mechanism underlying human sex-determination appears to me to be as well-established as anything in biology; later theories of sex-determination must either build on this basis, or if they advance a new basis, the practical result must be essentially the same (in the same way that the theory of Einstein, though it builds on a wholly different basis from the Newtonian, introduces only negligible alterations into the practical results of, say, geometry).

* For a detailed treatment, an article by the same author in DISCOVERY for August and September, 1922, should be consulted.

* The chromosomes are, of course, the microscopic "organs" within the cell which are the chief bearers of heredity,

Now for our authoress. She certainly does not demonstrate that the current explanation is false; in fact, she has the temerity not to discuss or even to mention it at all! Neither does she show how the two might be reconciled. On the other hand, it is true that a possible mode of reconciliation exists. For instance, if ova from the left ovary only admitted X-bearing sperms, and those from the right only those without X, a formal reconcilement would be given. But in the first place, what a complex and apparently unnecessary arrangement this would be! In the second, though not impossible, it would run counter to our general knowledge of fertilization.

However, if a reconciliation of this sort were proved to be really necessary, biologists would naturally have to attempt it, and would welcome the addition to knowledge which it involved. But, unfortunately, this proof is exactly what Mrs. Erskine does not give us. In place of the method of science—the actual data tabulated and on file forever so that each reader may form his own judgment—we have a series of assertions. Not only that, but sometimes the assertions do not bear out the authoress. For instance, she states that her theory has worked in over 80 per cent of cases. But what about the remainder? If it is as simple as we are asked to believe, it should work without exceptions.

To sum up, Mrs. Erskine has not brought forward evidence which is even approximately sufficient to make biologists pay attention to her theory on its merits; further, her theory conflicts with the facts which are definitely known about sex-determination; and, though a reconciliation is not impossible, it would involve various improbabiiities.

Mrs. Erskine is clearly a sincere and self-sacrificing person who has spent much time and labour in working for the cause of women. But that does not make her thesis true. From the point of view of science her book as it stands is worthless, and until she gives us conclusive evidence, properly presented, in support of her theory, we cannot expect the man of science to pay it serious attention.

"Sex at Choice," by Mrs. Monteith Erskine. (Christophers, 7/6 net).

Books Received.

Motion of Electrons in Gases. By JOHN S. E. TOWNSEND, M.A., F.R.S. (Oxford University Press. 2*s.* 6*d.* net).

Annals of Archaeology and Anthropology. Vol. XI. Nos. 3 and 4. (University Press of Liverpool. 6*s.* quarterly).

Proetus or the Future of Intelligence. By VERNON LEE, Litt.D. (Kegan Paul. 2*s.* 6*d.* net).

Textbook of Wireless Telegraphy and Telephony. By W. GREENWOOD, B.Sc. (Eng.), A.M.I.E.E., A.C.G.S. (University Tutorial Press Ltd. 5*s.* 6*d.*).

Bulletin of the National Research Council. Second edition revised. By FRANK AYDELOTTE. Vol. 10. Part 2. April, 1925. No. 52. (National Research Council).

Colour Blindness. By MARY COLLINS, M.A., B.Ed., Ph.D. (Kegan Paul. 12*s.* 6*d.* net).

Electricity and the Structure of Matter. By L. SOUTHERNS, M.A., B.Sc. (Oxford University Press. 2*s.* 6*d.*).

The History of Mathematics in Europe. By J. W. N. SULLIVAN. (Oxford University Press. 2*s.* 6*d.* net).

The Crystalline State. By SIR WM. HENRY BRAGG, K.B.E., D.Sc., F.R.S. (Oxford University Press. 2*s.* net).

Eclipses of the Sun. By S. A. MITCHELL. (Oxford University Press. 25*s.* net).

Observation. Summer 1925. (Leplay House Press. 1*s.* net).

The Microstructure of a Coal Seam. By J. LOMAX, F.G.S., A.L.S. (H.M. Stationery Office. 4*s.* 6*d.* net).

The Distribution of Thunderstorms over the Globe. By C. E. P. BROOKS, M.Sc. (H.M. Stationery Office. 2*s.* net).

The A.B.C. of Evolution. By JOSEPH MCCABE. (Watts & Co. 1*s.* 6*d.* net).

Essentials of Scientific Methods. By A. WOLF, M.A., D.Litt. (George Allen & Unwin Ltd. 5*s.* 6*d.* net).

The Einstein Theory Explained and Analysed. By SAMUEL H. GUGGENHEIMER. (Macmillan & Co. Ltd. 10*s.* 6*d.* net).

Sir Charles Napier. By T. RICE HOLMES. (Cambridge University Press. 7*s.* 6*d.* net).

An Introduction to Kants' Philosophy. By NORMAN CLARK. (Methuen & Co. Ltd. 10*s.* 6*d.* net).

Physical Geology. By WM. J. MILLER. (Chapman & Hall Ltd. 13*s.* 6*d.* net).

The Electron. By ROBERT ANDREWS MILLIKAN. (University of Chicago Press. 9*s.* 6*d.*).

A Treatise on Electricity. By F. B. PIDDUCK. (Cambridge University Press. 21*s.* net).

Relativity. By SIR OLIVER LODGE, F.R.S. (Methuen & Co. 1*s.* net).

The Sensory Basis and Structure of Knowledge. By HENRY J. WATT, D.Phil. (Methuen & Co. 8*s.* 6*d.* net).

Proceedings of the Society for Psychical Research. Part XCIV. Vol. XXXV. May, 1925. (Robt. Maclehose & Co. 7*s.* net).

Poetry. Vol. 8. No. 72. June, 1925. (Merton Press Ltd. 1*s.* monthly).

A Survey of the Silk Industry of South China. By C. W. HOWARD and K. P. BUSWELL. Jan. 1925. Agricultural Bulletin No. 12. (Dept. of Sericulture. $1 Hong Kong currency).

A Catalogue of British Scientific and Technical Books. New edition revised and enlarged. Compiled by THE BRITISH SCIENCE GUILD. (A. & F. Denny Ltd. 12*s.* 6*d.*).

The British Journal of Psychology. VIII. *A Study of Practical Ability.* By MARGARET MCFARLANE, B.A., Ph.D. (Cambridge University Press. 7*s.*).

Aerial Surveying by Rapid Methods. By B. MELVILL JONES and MAJOR J. C. GRIFFITHS. (Cambridge University Press. 16*s.* net).

The Story of Electricity. By W. F. F. SHEARCROFT, B.Sc., A.I.C. (Ernest Benn Ltd. 2*s.* 6*d.* paper; 3*s.* 6*d.* cloth).

Drift, the Fish Controller.

By T. W. Jones, B.Sc.

Our scientific study of marine biology and oceanography will in years to come be ranked as one of the most important of our practical contributions to knowledge. Drift is one of the great unknown factors which influences our fish harvest. New instruments have had to be devised in order that it may be brought into calculation as a known rather than an unknown factor.

A FLOATING bottle may awake in the mind of the watcher pleasant memories of convivial friends, or merely a desire to throw stones at the fortuitous target, to sink with a broadside the miniature craft. It were better, however, that he examine the bottle, see what it may contain. Though the optimistically romantic may hope for a message from shipwrecked mariners, he is more likely to find a questionnaire paper from a student of oceanography, who, desiring to discover the set of tides from a particular spot, has set adrift a number of these bottles containing papers asking the finders to furnish him with details as to the date and place of finding. By collecting information in this manner it is possible to plot the course of the surface currents of a sea or, as it is more properly called, to plot the surface drift.

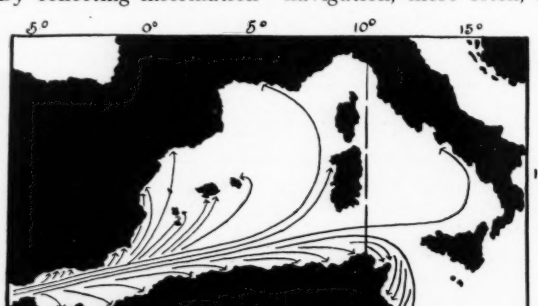


Fig. 1.—THE SURFACE DRIFT OF THE MEDITERRANEAN IN JANUARY AND FEBRUARY.
Compiled from drift bottle experiments, of Johannes Schmidt, Ph.D., and Giovanni Platania, carried out in 1912 and 1913 respectively.

Plankton.

Apart from local phenomena like tides and currents, there are bodily movements of water around the earth, whereby the water of the earth is continually circulating and carrying with it the minute and relatively inert organisms, collectively named by Victor Hensen about 1887 the plankton, a name that has been universally adopted since Ernst Haeckel wrote his epoch-making paper "Planktonstudien." This writer further gave us the two names benthos and nekton. The former of these is used to denote the living organisms like worms, that live on the sea bottom or attach themselves, like anemones or barnacles to rocks, piers or even to each other. Nekton is used to denote those organisms that, like the fishes, swim and so can move about the seas independently of drift and current influences. Although most of the organisms of the plankton are provided with minute locomotory organisms as cilia or flagellæ, they do not alter their environment at will, they cannot assume the nektonic habit, as it is called, and are moved about the ocean by the bodily movement of the water surrounding them, *i.e.*, they drift. Hence the study of drift is intimately connected with the study of the plankton, and so with the movement and maturation of fishes, since the planktonic organisms form the food of hosts of fishes and invertebrates, and their embryos.

This drift of water around the earth must not be confused with the more obvious movements of water that are so important from the navigational point of view, the tides and currents. Although, of course, a surface drift may sometimes be so strong as to affect navigation, more often, however, its effects are completely masked by surface currents occasioned by tidal ebb and flow. Water may drift at all depths of the ocean, depending upon its density or specific gravity, a property that is intimately bound up with its temperature and salinity (or amount of dissolved salts it contains). Drift is also influenced by the rotation of the earth and, on the surface and a little below it, by the wind.

It will perhaps give the reader a clearer understanding of the problems concerned with drift if we take a typical example of such bodily movement of the sea.

The Gulf Stream.

The sun's rays heat the Atlantic surface water at the Equator, and the south-eastern trade wind blowing on the surface sets it drifting in a westerly direction. The westward movement coupled with the sun's heat causes more water to well up from the colder depths, and this in turn moves westward. We thus have a surface stream of warm water in the Atlantic flowing westward and known as the Equatorial Stream. When this reaches the land barrier of the Antilles it is not stopped but deflected or, as a matter of fact,

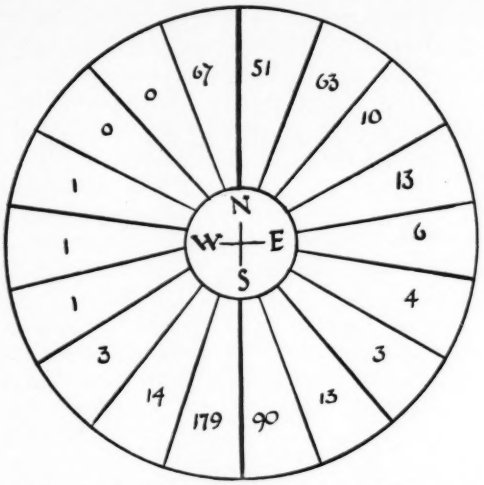


Fig. 2.—Distribution of the Balls after the test of the 17th and 18th Oct. 1924 off the St. Nicholas Lightship, off Yarmouth.

split into two main streams. That on the northern side of the Equator is turned to the right, or the north, under the forces set up by the earth's rotation; that on the southern side of the Equator being deflected to the left under similar forces. Thus, in travelling across the Equatorial Atlantic the water has come under the influence of three forces: temperature changes, wind action and earth action. The northern stream, after leaving the Antilles, flows in a north-westerly direction as the Antilles Stream to the Gulf of Mexico, whence the main drift issues by the Straits of Florida as the warm and saline Gulf Stream, turned again by the earth's motion to the right so that it now flows approximately N.E. At about 41° N. the Gulf Stream impinges upon the cold Labrador Stream flowing down from the polar seas along the western coast of Greenland. Both are deflected to the right, the Gulf Stream flowing nearly due east and the Labrador Stream to the west down the east coast of N. America. Some of the Labrador Stream, however, being so much colder than the Gulf Stream and therefore denser, sinks and passes below the latter to the Equator where some of it wells up to the surface and becomes the Equatorial Stream.

Parting Ways.

Part of the Gulf Stream also turns to the right and forms the eddy known as the Sargasso Sea, the remainder flows across to Europe and is deflected northwards by the warm and dense drift flowing out of the Mediterranean, into the Faroe-Shetland channel where it joins and spreads over the surface of the colder Norwegian Sea. It has, in this long journey, been considerably cooled and therefore parts of it, though still warmer than the water of the Norwegian Sea, have a higher salinity and so sink below that sea, forming vortices. The main stream, however, flows into the Arctic Sea and continues its journey, growing colder until in all probability it becomes one of the cold drifts flowing down again to the Equator. Locally, tides, winds and the sun's rays have considerable influences upon the course of drift. Another factor besides temperature changes that produces sinking and welling up of the water are variations in the depth of the sea. Vortices are thus produced and since they have a profound effect upon the planktonic organisms they demand careful study.

The Determination of Drift.

Since local atmospheric conditions, temperature and wind, have such a profound effect upon drift, it is obvious that the floating bottle method can only give an approximate idea of the drift in a small sea bounded by inhabited coasts, whereon the bottles can land and the questionnaire papers be returned to the investigator. By such means Professors Johannes Schmidt and Giovanni Platania broadly drew the course of the Gulf Stream drift into the Mediterranean Sea, and from their charts Fig. 1 has been compiled. This, however, takes no account of local variations or the movements at depths below the surface. Further, no reliable results could be

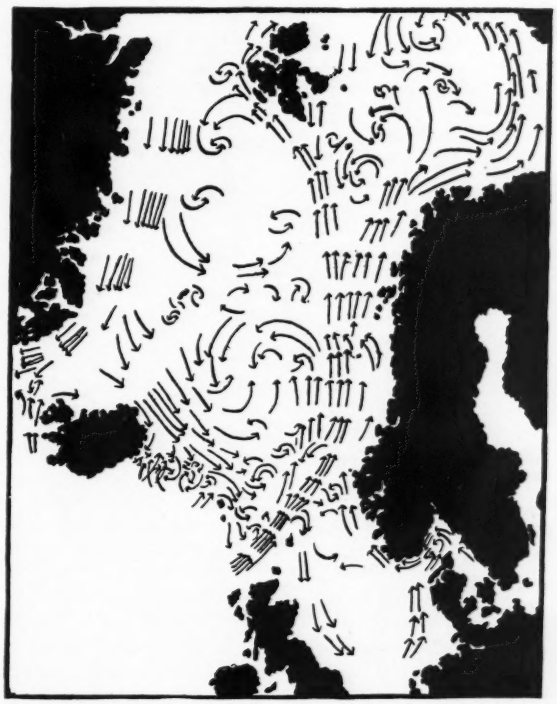


Fig. 3.—Drifts of the Norwegian Sea. Compiled from Drift Indicator Work by Nansen and Hjort, 1909.

gained by the use of this method in an open expanse like the Atlantic where we know from the courses taken by derelict wrecks that the drift outside the few main streams is very erratic indeed. Accordingly, instruments have been devised whereby the drift can be determined at any depth. These are based more or less upon the scheme of a weathervane. Let down into a current a vertical vane attached to the side of the instrument keeps it turned to the current whilst other vanes rotating on a shaft record the velocity of the current, the direction of which is ingeniously recorded by balls dropping on to a compass needle so grooved that the balls roll off its end into compartments arranged like the cardinal points of a compass. By calculating the currents due to tidal motion and deducting them from those recorded, the residual current, or drift, is calculable.

A new instrument that embodies all the good features of earlier ones has been recently perfected by Mr. J. N. Carruthers, M.Sc., D.I.C., of the Lowestoft Fisheries Laboratory. This, a photograph of which is shown in Fig. 4, enables the investigator to determine the drift at a particular point more or less automatically without the exhaustively intensive measurement and laborious calculations that were required with previous forms of apparatus. Furthermore, the apparatus once it has been calibrated may be left under water for any length of time, as against the older types that had to be hauled to the surface every time a measurement had been made.

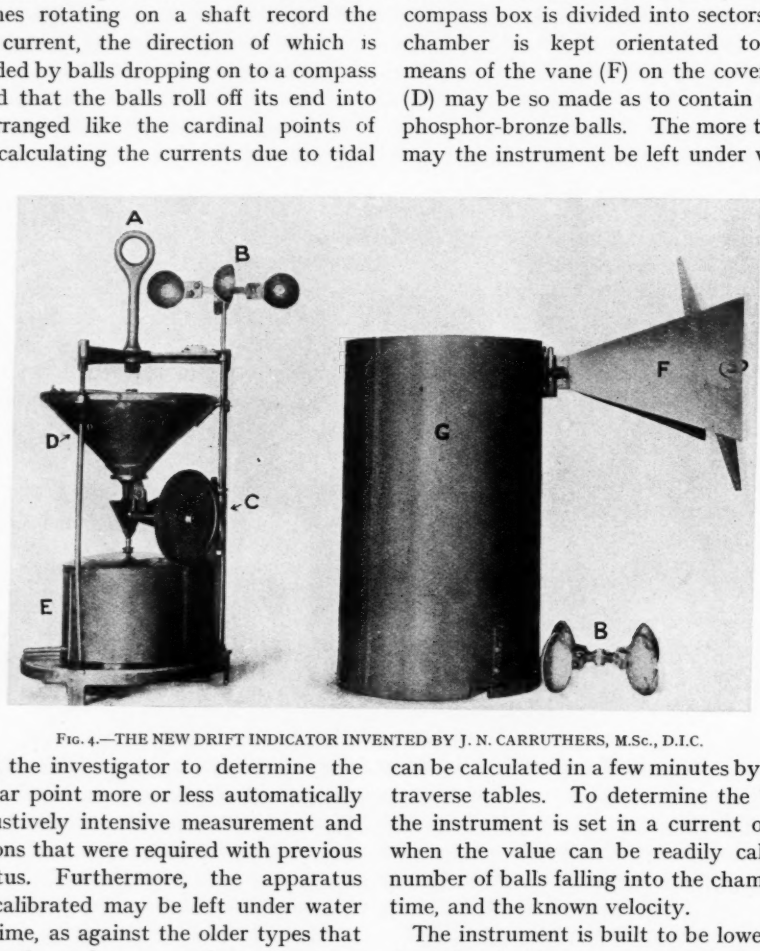


FIG. 4.—THE NEW DRIFT INDICATOR INVENTED BY J. N. CARRUTHERS, M.Sc., D.I.C.

The Details.

In this new instrument (A, Fig. 4), which has come successfully through its preliminary tests off Yarmouth, a set of cups (B) very similar to those used in wind gauges rotates in the current. These are connected through gearings (C) with a mechanical arrangement by which phosphor bronze balls are released from the containing hopper (D) at a predetermined rate and allowed to fall on to a specially grooved magnetic needle. Down this they roll to fall off the end into one of the radially divided compartments in the chamber (E). A diagram is given of the compartments in Fig. 2 which also shows the distribution of the balls after a twenty-four-hour test made on 17th-18th October, 1924, and from this it was calculated that the drift was four and a half miles in twenty-four hours in the direction S. ca. 50° E. magnetic. The compass box is divided into sectors of 20° each. The chamber is kept orientated to the current by means of the vane (F) on the cover (G). The hopper (D) may be so made as to contain many thousands of phosphor-bronze balls. The more there are, the longer may the instrument be left under water. The instrument used by Mr. Carruthers in his preliminary tests delivered 700-800 balls in twenty-four hours. Steel balls are unsuitable for use, as they would affect the magnetic needle.

Setting.

Once the instrument has been calibrated, *i.e.*, the "mileage" value of the balls determined, the drift can be calculated in a few minutes by means of ordinary traverse tables. To determine the "mileage" value, the instrument is set in a current of known velocity, when the value can be readily calculated from the number of balls falling into the chamber (E) in a given time, and the known velocity.

The instrument is built to be lowered on a line over the side of a boat; upon the length of line paid out depends the depth at which the instrument makes its record. Needless to say, the apparatus should hang practically vertical and free from any rotational movement of either the boat or the line. The boat must be perfectly stationary, must not be carried along the surface by the wind or a surface current, or the records will be vitiated. Hence the boat, whatever its size, should be very firmly anchored. By anchoring fore and aft a small boat that offers

little resistance to wind and tide it has been found possible to hold it perfectly steady for hours, even over relatively great depths, where currents are always at their maximum.

The Effect of Drift on Embryonic Fish Life.

Since drift is so profoundly influenced by local conditions, it is necessary before we can predict authoritatively the motions of the plankton to study the drift and the conditions affecting it in any particular area for many years. The study must be as local as the variations, before it will be possible to formulate comprehensive generalizations or laws upon which to base our predictions. Not only does the plankton contain the food of many fishes and invertebrates, but at certain seasons of the year, depending upon the climate, it contains embryonic fish and invertebrate life. At some part of their early life all benthic and nektonic forms pass through a planktonic habit, some of them as eggs, others as larvae. The cod extrudes its eggs into the open sea. The herring deposits its eggs upon the sea bottom. After a short period of development on the bottom these herring embryos rise and go through their planktonic habit. Benthic organisms like the barnacle also have a planktonic phase during the larval period; by this means they are disseminated over a wide area, and the propagation of the species given wider opportunity than would occur if they were attached permanently to the parent colony. All these embryonic organisms have an extremely rapid metamorphosis which is simultaneous in any particular shoal. They suddenly throw off the planktonic habit and assume that of their species. This is the stage where extinction of the particular shoal may take place. If the drift of the plankton has taken these embryos into physical conditions unsuited to the adult habit of their species, such as an unsuitable salinity, temperature or depth, they must inevitably die on the completion of their larval state. Thus the harvest of which they would have formed a part will be depleted, as happened to the yearling haddock of the North Sea in 1921 and 1922. On the other hand, the conditions must have been exceptionally well suited to the 1904 brood of haddocks, as the 1907 fishery was extremely abundant. (A haddock of market size is usually about three to four years old).

The more we learn about the mass circulation of the seas the more fully shall we understand the laws that control fish biology, and the sooner make a truly economic use of the wealth still practically untouched, that lies ready to our hand did we but know how to gather it. By such knowledge we could avoid the pitfalls laid by ignorance. An example that may be cited is the destruction of local salmon harvests in certain American waters where salmon canners paid dearly for their ignorance. They truly killed the fish that laid the golden eggs by their ingorance of what seems to be a basic law of the sea—that you cannot take more than a certain percentage of fish annually from any one area. If this percentage is exceeded the planktonic equilibrium appears to be upset and the harvests gradually fall to zero.

CORRESPONDENCE.

To the Editor of DISCOVERY.

"The Origin of the Maya Culture."

SIR,

My attention has just been called to an article by Mr. Edward C. Rashleigh in the June number of DISCOVERY, in which frequent reference is made to my views on what he calls "the enigma of the origin of the Maya Culture." Perhaps you will permit me to comment on certain points in his argument.

Mr. Rashleigh pours scorn upon my identification of the Copan sculptures (Stela B) as elephants; but at the same time he tacitly repudiates the view of his chief authorities that the creatures are parrots (macaws) and solemnly adopts Dr. Forbes's amusing fantasy that they are squids or other cephalopods!

But Mr. Rashleigh and the learned archaeologists who are uncertain whether the elephant-like creature is a tapir, a tortoise, a macaw or a squid seem to overlook the fact that the elephant presents unmistakable distinctive features which any man, whose mind has not been warped by too much learning, or for that matter any child unhesitatingly will identify as an elephant. I have tried the experiment scores of times, and have never yet met anyone, man, woman or child (apart from an elect group of about eight ethnologists) who did not scorn as absurd the idea that Maudslay's pictures of the top of the Copan Stela B were not elephants.

Like so many recent critics Mr. Rashleigh repeats the statement that the Copan elephant has no tusks. This is not true. The tusks are clearly represented in accordance with the same convention as prevailed in Eastern Asia in the early centuries of the Christian era.

This is not the only misrepresentation in Mr. Rashleigh's article. But I need refer only to one other to indicate the questionable methods to which my critics resort. He endeavours to create prejudice by suggesting that Messrs. Channing Arnold and E. J. Tabor Frost are among my authorities, for, to quote his innuendo, "be it noted Professor Elliot Smith quotes," from their book. What I did quote—the only reference to them—was a preposterous and unfair attack upon a particular passage in their book by Dr. S. G. Morley. My object was to expose the hollowness of Dr. Morley's criticisms, for the passage was the statement of an unquestionable fact.

I call attention to Mr. Rashleigh's dialectical manoeuvres simply to suggest to readers of his argument the need to check his references. His ideas of logic will be apparent to any careful reader of his article.

University College, London. G. ELLIOT SMITH.

13th June, 1925.

Photomicrography.

By E. H. Ellis, F.R.M.S.

One of the most interesting branches of research work is the recording of microscopic material by means of microphotography. Very perfect machinery has been evolved to meet the needs of the worker and great advances have been made in technique.

As a result of the modern growth of scientific investigation routine methods of technique have undergone rapid development as their need has been increasingly felt and their application extended. One essential part of scientific work is the making of records. The accurate recording of microscopic detail presents certain difficulties and the application of photography to such work offers many advantages. Photomicrography—the process of photographing objects under a microscope—is gradually approaching nearer to perfection as its possibilities in new fields are tried and its deficiencies realized.

When photography was still in its infancy, but had so far emerged from the experimental stage as to be in common use, the microscope had already undergone sufficient optical and mechanical development to be a familiar instrument.

In these circumstances it was natural that an attempt should be made to record microscopic objects by photographic means. Thus it was in the Victorian daguerreotype days that the first photomicrographs to be published appeared in the first volume of the *Journal of the Royal Microscopical Society*.

Since that time photomicrography has undergone many changes in order to meet the needs of all branches of scientific work. The general trend of these changes has been in the direction of the rapid production of accurate, automatic, unbiassed records in place of drawings of objects which involve a degree of personal selective skill, either conscious or unconscious.

The development of the subject in this country and the formation of the Photomicrographic Society in 1911 are mutually related as cause and effect. So many new working methods have been developed that the subject is becoming more and more complex as it offers more perfect control over the final result.

Development of Apparatus.

The days of photomicrography with a microscope and camera balanced upon piles of books have gone for ever. The fact that the oil lamp still remains is possibly only because certain conservative members of the old school of photomicrographers are yet with us.

The modern worker finds he is less and less capable of coping with the amount of work to be done, and can spare time only for essential matters. As in other subjects, the time spent in repeating processes constantly must be reduced to a minimum.

To this end various modifications have been made of late years in the design of the bench for photomicrographic work.

The principles of a bench for photomicrography are those of the optical bench, which requires all components of the apparatus to be central about one axis. The effort to centralize the various parts of the apparatus is usually one of the most lengthy operations in photomicrography and, in consequence, the designers of modern apparatus have arranged for adjustments to a common axis to be as automatic as possible.

There are financial and other advantages in having a photomicrographic bench so arranged that the microscope is not a fixed part of the apparatus. An object can then be observed under the microscope on the laboratory table, the microscope transferred to the photomicrographic bench and a photograph made.

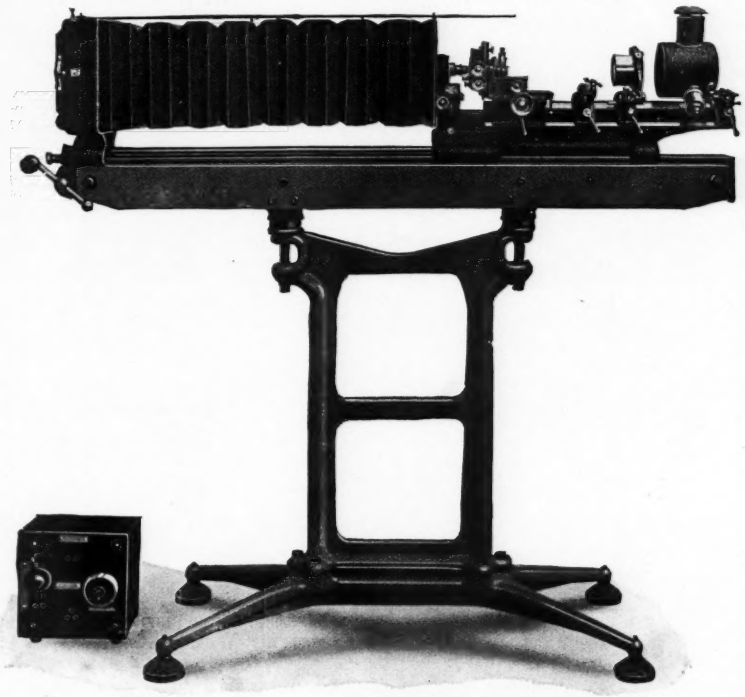
Most photomicrography is done on the conventional horizontal bench. It often happens, however, particularly in biological work, that photographs are required from temporary preparations mounted in fluid media. For such purposes it is usual to have a camera arranged vertically. With this in mind many benches have been produced capable of being used in either horizontal or vertical positions. Such benches, particularly dear to the heart of the continental designer, although seemingly advantageous often are, unfortunately, mechanically unsound, with the result that the camera vibrates.

A very convenient form of apparatus for vertical work is one based on a principle which is a modification of an old idea in photomicrography. If the lens of a hand camera is set at "infinity" and then placed in the plane of the Ramsden disc of a microscope, a photograph can be made. The hand camera lens magnifies the image of the Ramsden disc.

In a small apparatus of recent design, the camera, which weighs only eight ounces, replaces the ordinary eyepiece. The eyepiece of a side telescope is focussed upon fiducial lines in the eyepiece, and with the fine

adjustment of the microscope the image of the object is then focussed in the same plane. The focal plane of the telescope corresponds with that of the ground glass screen, so that an object seen in critical focus with the telescope will automatically be in similar focus on the plate.

One recent design of the horizontal type of bench constructed on engineering principles has broken away from tradition with certain advantages. It is impossible to transfer a microscope from a laboratory table to a photomicrographic bench without disturbing any of the adjustments. One way of evading such a difficulty is by ensuring that it does not arise, which in this matter can be done by fixing the microscope to the bench. Under such conditions there is no obvious reason why a microscope of the usual form should be used at all, provided that optical bench principles are observed. The conventional microscope has been deposed from the bench illustrated here, and in its place is a microscope and camera structurally united as one piece of the apparatus. The illuminant, condensing system, etc., are mounted on a small triangular bar which in turn travels on a carriage way. The operator seats himself at the focussing screen end of the apparatus. By means of a crank handle the small bar is run along the carriage way and brought close to the operator for visual work (with the focussing screen swung to one side) and then run out again to a suitable distance for photographic purposes. Special attention was given during design and manufacture to rigidity, fine adjustment, rapid removal and accurate return of the various components to the optical axis.



A MODERN HORIZONTAL BENCH FOR PHOTOMICROGRAPHY.
The fine and coarse adjustments can be seen below the focussing screen.
By courtesy of Mr. M. T. Denne, O.B.E., F.R.M.S.

Many recent developments of illumination have had their effect upon photomicrography. The essentials of an illuminant for optical work are that it shall be of a high intrinsic brilliancy, shall give out a minimum of heat, and shall be as near as possible to the point of light beloved of optical theory. It has been strongly urged and possibly nearly as often denied that a point of light is an ideal light source for photomicrography.

Illumination.

Those who dispute this and would substitute a relatively large surface of uniform intrinsic brilliancy base their assertions also upon hypothetical considerations. Much good work has been done by both methods.

For years, almost the only alternatives to the oil lamp have been incandescent gas and various forms of electric light. The incandescent gas mantle has the disadvantage that the image of the mantle web is apt to be outrageously obvious. The various modifications of the mantle, wherein a small bead of flame impinges upon a solid pellet of thorium or zirconium mounted on platinum wire, are in wide use. Before the war the chief forms of electric illuminants used were the arc lamp and the Nernst lamp. The Nernst lamp is now unobtainable and the arc lamp was never in great general favour on account of its inconstancies. Since the war, however, there has been a new era in illumination, and we have now developments of the arc lamp of the Pointolite type (tungsten arc in nitrogen) and gas-filled metal-filament lamps which give a constant light of high initial brilliancy and require no attention while working. Illumination troubles are therefore largely a thing of the past, and as it has been laid down by Abbé

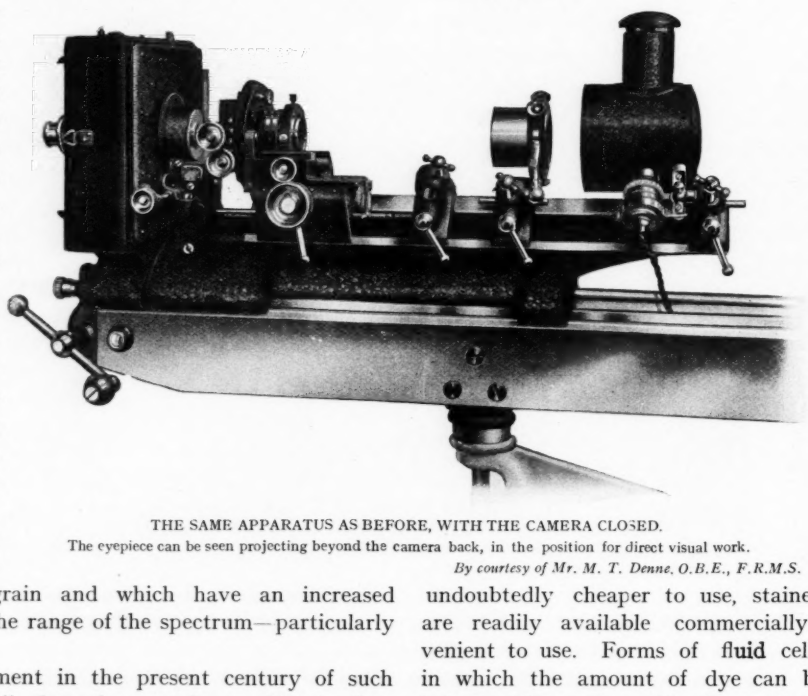
that a better optical image is obtained with a more powerful light source, there should be consequent improvement in the final photograph. So powerful, indeed, are some modern illuminants that on occasion exposures are apt to be quite inconveniently short. This has been countered in two ways: first, by the introduction of a quickly-acting and, as far as possible, vibrationless shutter, usually either in the focal plane or immediately over the eyepiece; and secondly, by the use of neutral light filters which cut down the actinic value of the light equally along the length of the spectrum.

Great improvements have also been made in optical aids to illumination—for example, condensers. In particular the various methods of vertical illumination for metallurgical work should be noted.

Much research has been done of late years in various commercial laboratories on the properties of photographic images.

Colour Sensitive Plates.

Some of the practical results are the production of plates coated with an emulsion which is more rapidly affected by light, which have a finer grain and which have an increased sensitivity to the range of the spectrum—particularly the red end.



THE SAME APPARATUS AS BEFORE, WITH THE CAMERA CLOSED.
The eyepiece can be seen projecting beyond the camera back, in the position for direct visual work.
By courtesy of Mr. M. T. Denne, O.B.E., F.R.M.S.

The development in the present century of such "panchromatic" plates has not been without effect upon photomicrography. An ordinary photographic plate is affected chiefly by light from the ultra-violet, violet, and blue parts of the spectrum; consequently, if a coloured object is photographed, the value of the colours in monochrome may not accord with their visual appearance. This would obviously be undesirable in many branches of photomicrography. For example, it is a commonplace in many departments of biology that some tissues exercise a selective absorption on dyes. Consequently, should a preparation of any material be stained in various colours it is important that the colour values in a photographic record should be accurately rendered. The commercial "panchromatic" plate which is bathed in various dyes to give it increased sensitivity towards the red and green parts of the spectrum, is still unduly sensitive to the violet end. To balance this, yellow light filters are used to absorb the excess of violet. In photomicrography, given a plate sensitive to all regions of the spectrum and a series of light filters of known definite absorption, perfect control of colour values can be exercised. If it is desired to photograph a coloured object to give the maximum possible contrast, light must be used that is complementary to the colour of the object. If maximum detail is required, light of the same colour as the preparation should be used.

There are various methods of obtaining light of a definite wavelength, the most common of which is by the use of appropriate light filters with definite transmission bands.

Light Filters.

Such light filters may be either stained gelatine, or cells containing fluid. Although fluid cells are undoubtedly cheaper to use, stained geatine filters are readily available commercially and are convenient to use. Forms of fluid cells are available in which the amount of dye can be easly varied, but must be used cautiously as the fluorescence of many dyes may make the spectroscopic value of a deep cell difficult to determine.

A different method of producing a similar result is by further selection of the illuminant. For example, a mercury-vapour lamp which transmits a bright line in the yellow, green and blue regions of the spectrum, used in conjunction with a screen that will only transmit one of the lines, is valuable in dealing with difficult objects. For example, the yellow mercury-vapour line used on objects stained with methylene blue will give the utmost contrast.

Further, light can be split up by a prism or a diffraction grating and only a selected portion of the spectrum allowed to fall upon the object. In practice this method often fails because of the loss of light it entails.

The gradual perfection in recent years of methods of colour-photography has caused it to be used successfully in photomicrography, probably chiefly in connexionwith polarized light in petrology.

Ultra-Violet Light Photography.

One method of extending the ordinary limits of microscopic resolution is by using monochromatic light of a short wave-length. Ultra-violet light which fulfils these requirements cannot be seen, so that examination of objects by this means must be through the medium of photography.

Kohler, in 1904, designed a monochromatic objective for Zeiss to enable photographs to be taken with light of a wave-length of 2,750 Å.U. This objective had a numerical aperture of 1.25, but owing to the use of ultra-violet light gave a resolving power equal to that given by an ordinary objective with a numerical aperture of 2.5, supposing such an objective could be made. The lenses were of fused quartz. (Ordinary quartz cannot be used because it is birefringent; it must therefore be made amorphous by fusing.) So far only a few workers have used ultra-violet light for photomicrography. In this country such work is associated largely with the name of Mr. J. E. Barnard, F.R.S. Another well-known worker was the late Professor K. Kruis of Prague, who produced many good results by this method just before the war. Kruis worked with immersion "monochromat" objectives. The immersion fluid used was a mixture of glycerine and water in place of the usual cedar-wood oil. All the glass in the photographic apparatus, all lenses, 3 × 1 slips and cover glasses had to be replaced by quartz, as ordinary glass will not transmit ultra-violet light. The ultra-violet light was obtained from a high-tension current (10,000 volts) arc between electrodes of either cadmium or magnesium. The beam of light was split by prisms into a spectrum. The unrequired rays were cut out by a screen and the rest passed on through the microscope. The image was focussed on to a special screen of uranium glass. Kruis afterwards found that cadmium light of 2,750 Å.U. gave better results than the magnesium light of 2,800 Å.U. Later he improved on the method of focussing a shadowy image on the uranium screen. The object was first examined with sodium light by an ordinary low-power objective (such as the Zeiss "D"). The "monochromat" objective and quartz ocular were then put into place and ultra-violet light used. Experiments showed that by moving the micrometer screw a determined definite amount after the image was focussed by the sodium light under the Zeiss "D," it would automatically be in critical focus with the cadmium light and the "monochromat" objective. Kruis found that with the "monochromat" objective a x 7 quartz projection ocular and a camera extension of 25.4 cm., the exposure required was as a rule about thirty seconds.

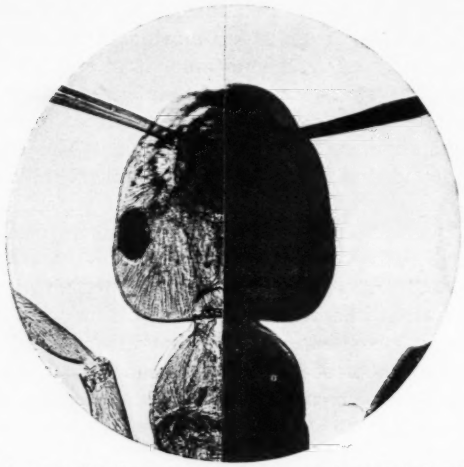
The advantage of photography by ultra-violet light is that the resolving power of the objectives is greatly increased, and also that in unstained preparations, differences in transparency occur due to varying absorption by the various histological elements, corresponding to fine details of structure. Consequently unstained objects appear as they would if they were stained and examined by white light.

Living objects are very susceptible to ultra-violet light, and exposure is liable to cause troublesome artefacts; nevertheless, exposures can be made sufficiently short to obtain photographs of unaltered living objects.

Kinematography with a Microscope.

Before the kinematograph, developed to its present extent as an instrument of popular amusement, it was thought that its chief use would be as an aid to scientific research. Its applications to the recording of moving microscopic objects form possibly some of the most alluring potentialities of modern photomicrography. The results that have been obtained can be roughly divided into three groups according as to whether the exposures have been made below, at, or above the normal speed (sixteen exposures per second) required to make the projected results approximate to the visual appearance of motion.

Equipped with suitable apparatus the difficulties in the way of taking kinema films of microscopic objects are not so great as might perhaps be expected. There is no great trouble about exposure if a powerful light source is used—usually an arc lamp, with the image of the crater of the positive carbon carefully focussed on to the microscope substage condenser. It should be borne in mind in this connexion that the size of the image required on a kinema film is small, and that consequently the light source can be of a less intrinsic brilliancy than if a larger image were required. To point out the possibility of photographic images being formed after very brief exposure to light it may be noted that in order to analyse a series of high-frequency electric sparks kinema films have been said to have been made at most astonishing speeds.



Photomicrograph of the head of an insect to show maximum contrast and detail produced by the use of colour filters.
By courtesy of Kodak, Ltd.

The method whereby successive photographs are taken at a speed less than normal is essentially the " chrono-photograph " method by which kinema films of the opening of flower buds have been prepared. This was probably the first method to be used in conjunction with a microscope, and by it records were made of such processes as the formation of crystals.

The application of the kinema to the microscope would obviously be chiefly in connexion with the study of living material. The photography of such objects, however, involves the difficulty that light of sufficient intensity to permit the necessary short exposure would also give out sufficient heat to kill the organisms. In kinematography it is necessary to have a shutter to cover the film during the period between each successive exposure when the film is moved down the length of one image ; the difficulty caused by an intense beam of light focussed on living objects was largely overcome in some instances by using two such shutters, one in the normal position, and a second between the light source and the object, connected and working synchronously with the first. Kinema films of the movements of the intestines of various Daphnids, of colonies of Vorticellæ, of the movements of coloured fluid in the digestive parts of a frog, etc., have been prepared in this way. Even subjects requiring high magnification can be thus dealt with, and a film has been made showing the various stages in the segmentation of the egg of a sea-urchin (*Paracentrotus lividus* Lk.) which has been the subject of research on parthenogenesis.

Films taken at normal speed, *i.e.*, with an exposure of each image of 1-32nd of a second, have been made showing the undulating membrane of trypanosomes and the movements of spirochaetes in the blood. The dark-ground method of illumination was employed, which causes the objects to appear with brilliant outlines against a dark ground. The maximum power of light available was used, and thus, with the light source, the speed of the film, and the time of exposure being of necessity constant, the only factor easily varied was that of magnification. Experiment showed the best results to be obtained at a magnification on the film of 280 diameters.

Slow Motion Ultra-Microscopy.

The third method, of films taken at a speed above the normal—virtually the " slow-motion " method—has been used in connexion with the ultra-microscope. The ultra-microscope is an optical device that has been developed in connexion with the study of colloidal particles. It is essentially a method of illumination. The image of a light source is focussed upon an adjustable slit, an image of which 1-50th of its size is projected by a lens system horizontally through the fluid containing the particles to be examined. The result is that each particle is seen as a point of light (bearing no relation to the shape of the object) against a black ground. Kinema films of colloidal particles showing typical Brownian movement have been made. A high-power objective (Zeiss 2 mm. apochromat) was used in conjunction with a projection ocular giving a magnification on the film of 600 diameters. The images were obtained at a rate of twenty per second, with an exposure per image of 1-320th second. An analysis of Brownian movement can thus be made.

A B

Photomicrographs of the same section of an earthworm.
(*a*) On a panchromatic plate with a light filter ; (*b*) On an ordinary plate.
By courtesy of Kodak, Ltd.

The Value of Change.

By F. A. Hampton.

Go for a change is one of the oldest and simplest of prescriptions. Actually it depends for its effect on the reaction of the body to new stimuli.

All living organisms are engaged in a struggle to adapt themselves to their environment, and as the environment is continually changing, it follows that the adaptation can never be perfect unless we assume the existence of some creative principle which enables the organism to meet the new conditions as they occur. As the necessary changes seem to take place but slowly, it may be doubted whether such a principle, even if it exists, is very effective.

In man we notice that the adaptation to the change from a horizontal to an upright posture is still imperfect. The outlet of the large bone cavities beneath the eye provides an effective drainage system in the quadrupeds, but is inadequate in the upright posture, and the defect often needs to be corrected by the surgeon. A much more recent change in the life of civilized man is the increasing equability of his environment, and it seems likely that the failure of his physiological machinery to respond to this change is more important than is commonly supposed.

Humdrum Civilization.

Uncivilized man is constantly exposed to abrupt changes of temperature, to the stimulation of rough contact with the earth to physical fatigue and sudden exertion. His diet changes with the seasons and repletion is liable to be followed by periods of fasting. If he belongs to an agricultural or pastoral people his way of life and his occupation change regularly; if he is a hunter his life is still more varied and eventful.

The mechanism of civilization levels out these changes and the more civilized we become the more equable are our surroundings. The smoothness of our roads and pavements exacts only a stereotyped movement from a foot adapted to rough ground, and to this monotony an eminent surgeon attributes the commonness of "flat feet." The surface of the body is so efficiently sheltered from changes of temperature that when exposed to a sudden cooling it fails to respond adequately, the temperature falls and with it the resistance to infection, and the result is often a common cold. There seems to be a tendency in civilized people to increase the number of meals during the day, so that the physiological reserves are seldom exhausted and renewed, except in the few whose religion prescribes the sanitary regimen of periodic fasting.

The ingenuity of modern methods of preserving foods has caused a monotony in the meals of those whose natural and healthy epicureanism cannot find full play, and it has led to the disastrous tea and tinned salmon diet of so many city workers.

The seasonal variation of the food supply of primitive man and the slightness of the change that it underwent in cooking ensured an adequate supply of vitamins, so that the physiology of man has never been stimulated to manufacture its own vitamins and is as dependent upon raw food as any of the lower animals—a dependence that has only recently been brought home to us by the increased use of preserved and "denaturalized" foodstuffs.

It is not, of course, to be supposed that change is in itself "good"; it is a hostile factor which the organism is prepared to meet and counteract. Equability of the environment is, likewise, not "bad" in itself; it is only a condition of life to which our physiology, which is still that of primitive man, has not yet become completely adjusted. It remains for a future age to see whether the adaptation will be made or whether civilization will take a new direction. Meanwhile it is significant that the modern Englishman seeks unconsciously to reproduce the physiological conditions of primitive life by means of cold baths and strenuous exercise in the open air.

Fads as Fashions.

We feel the need of change to be imperative at holiday-time, and the desire to find adequately primitive conditions drives us further and further afield. Sun-bathing has become a medical treatment instead of a fad, and the cult of nakedness is making tentative efforts to revive. All these practices and pursuits are quite incomprehensible to people less civilized than ourselves whose mode of life renders them unnecessary.

Change has always been a favourite medical prescription, though in the times when all travel was arduous some elaboration of it was often necessary to overcome the patient's reluctance. The efficacy of that treatment for persistent jaundice, which recommends that the patient should look upon the Icterine warbler, when he would be instantly cured, may well have depended upon the change and exercise necessary

(Turn to page 269.)

The British Association for the Advancement of Science.

Meets this year at Southampton from Wednesday, 26th August to Wednesday, 2nd September. It will be an important meeting and very largely attended.

THE British Association has issued the preliminary programme of its annual meeting, which will take place in Southampton from 26th August to 2nd September inclusive, under the presidency of Dr. Horace Lamb, lately Professor of Mathematics in the University of Manchester. Southampton, which the Association has not visited since 1882, is one of the most interesting centres in the south of England for a meeting of this kind. Its university college, removed from the old cramped building in the heart of the town to a generous site on the outskirts, will house several sections of the Association, and affords an example of a great educational institution in the making. The town itself is a focal point of overseas communications, and with this feature and the railway centenary of the present year in view, the programme gives special attention to various aspects of transport. This will form the subject of two days' discussion in the sections of economics and engineering jointly, while Sir Archibald Denny, as president of the engineering section, will give an address upon fifty years' evolution in naval architecture and marine engineering, and an evening lecture will be given by Mr. R. V. Southwell on aeronautical problems of the past and of the future.

Among other addresses, that to the physical section by its president, Dr. G. C. Simpson, Director of the Meteorological Office, will deal with "The New Idea in Meteorology." The address by Mr. A. R. Kinks, Secretary of the Royal Geographical Society, as president of the geographical section, will be concerned with the science and art of map-making, a subject appropriate to the town which is the home of the Ordnance Survey. Professor A. V. Hill, presiding over the physiological section, will speak on the physiological basis of athletic records, and this section and that of psychology will jointly discuss the acquisition of muscular skill. Mr. Tate Regan, in the chair of the zoology section, will deal with "Organic Evolution: Facts and Theories." Dr. W. W. Vaughan, Headmaster of Rugby, will address the education section on "The Warp and the Woof in Education."

There is again a woman among the sectional presidents: Miss Lynda Grier, Principal of Lady Margaret Hall, Oxford, and a distinguished economist, will take "The Meaning of Wages" as the subject of her address to the section of economics. The many subjects already entered for discussion in the sections include the cost of farming and the marketing of agricultural produce; health in schools; the functional significance of size; the ignition of gases; the botanical geography of tidal lands; variations in gravitational force and direction; and recent investigations in the modern psychological field of vocational guidance.

The scientific interests of Southampton and its neighbourhood are exceptionally varied and attractive to visiting members, including the geographical and economic position of the town itself, the botanical study of the New Forest, the archaeological features of Stonehenge, Winchester, and other sites, and the geological complexities both of the mainland and of the Isle of Wight. General excursions will be arranged to these and to other points, including a visit to the Channel Islands after the meeting if there be sufficient demand; and particular scientific interests will be met by sectional excursions, such as the special visit of an anthropological party to Stonehenge, and inspections of the anti-gas school pontoon and diving-tender at Portsmouth and the aerodrome at Gosport, which are being arranged on behalf of the physiological section. The Association is maintaining its policy of attracting junior scientific workers to its meetings by making it possible for them to attend at a minimum cost, and as before has invited certain universities and colleges to nominate selected science students to "exhibitions" enabling them to participate in the meeting without expense to themselves. For the accommodation of these and other visitors the university college authorities at Southampton have placed at the disposal of the Association the excellent hostel attached to the college.

NEW ELEMENTS.

IT is reported from Berlin that Professor Walter Nonnack has isolated two new elements associated with the platinum-palladium group. The atomic numbers are 43 and 75, and the names of Masurium and Rhenium have been given to the new discoveries. It remains for other workers to confirm the report before it is finally accepted.

The Stoney Indians of the Bow River, Alberta, Canada

By L. H. Dudley Buxton, M.A., F.S.A.

The red man is a diminishing ethnological element, and it is important that records should be taken before the admixture of blood obscures the original stock. The modern scientist therefore goes head-hunting with a pair of calipers. This article gives an entertaining account of some of the difficulties of fieldwork in distant lands.

LAST summer, after the meeting of the British Association in Toronto, my wife and I, armed with many introductions from various Canadian anthropologists and generously financed with a grant by the British Association, went out to Alberta to study the anthropology of some of the Canadian Indians. Our purpose was quite clear: we wanted to measure the heads of as many full-bloods as possible, somewhere in the centre of Canada. The west coast had been carefully studied and there was a good deal of information about the eastern Indians. Little, however, was known about the central tribes.

We had therefore to trust to luck and hope that we should find Indians in this region who would not object to being made the subjects of scientific inquiry. At Toronto opinion was divided: the general opinion was that a lady could not stand the roughing necessary on a reserve; but my wife thought she could bear it and I wanted a skilled assistant, among whose duties would be not only to help measure the women, who are usually shy about being measured, but also to cook and assist in the keeping of what facetious people described as the "anthropological tipi."

THE AUTHOR'S SHACK.
The Indians' shacks are exactly similar, but they never sweep them out.

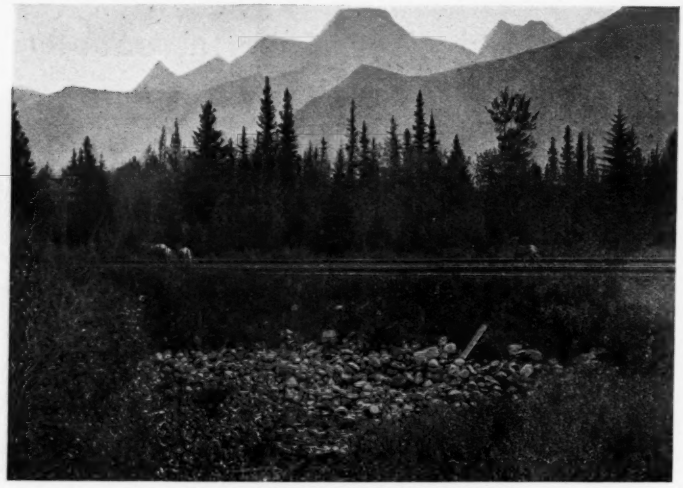
—and wife

But it was not as bad as that. Soon after we had arrived at Banff I went to see Mr. Luxton, who is an honorary chief of the Stoneys. He received me cordially, but seemed to hesitate a little about the reserve till I said my wife was with me. That altered everything; he had a very natural doubt about an anthropologist unassisted being able to survive, but as I had someone to look after me and help with the Indians, all was well. He motored us through the Rocky Mountain Park to Morley. The park is a forest reserve, and the wild animals, through being unmolested, have grown astonishingly tame. Some big-horn sheep can be seen feeding on the line quite close to the main road. The picture gives some idea of the scenery in the park, which lies adjoining the reserve.

When we arrived at Morley, the headquarters of the reserve, we were introduced all round and hired a shack. Before describing our shack, which was to be our home for the next few weeks, it may be interesting to describe the little colony of Whites who lived there and who were all responsible in various ways for the well-being of the Indians.

The Authorities.

The "agent" was in supreme command of the reservation and was ultimately responsible for everything that went on there. He had a very great sympathy for the Indians and governed them with a strong paternal despotism eminently suited to their needs. Next to his house was that of his clerk, while on the other side lived the Indian interpreter, as none of the officials knew Stoney. In the centre was the school and the headquarters of the Royal North-West Mounted Police. It is a tribute to the ability of that magnificent body of men that the policeman on the reserve had an absolute sinecure—he had not had a prisoner for a long time, so powerful is the established law. Near by was the mission. Only a few attended the school, but the church usually



ON THE EDGE OF INDIAN TERRITORY.
Rocky Mountain sheep crossing the railroad line.

held a fair number on Sundays as the Indians liked to sing hymns. The missionary did not speak Stoney—a fact which was a serious disadvantage in his work; nor did he seem to show that sympathy with the people which was so characteristic of the agent.

The third point of contact with the Whites other than law and religion was commerce. The store lay over the hill in the background. The Indians have been induced by a succession of traders to depend on many White goods which formerly would have seemed luxuries. They spend all the money they earn in the store. Their purchases were always the same: first, as much meat as they could afford; secondly, flour; and thirdly, clothing—especially bright Hudson Bay blankets, and boots and gaudy scarves. Some of them were very fond of buying lemonade, but most showed little imagination except in clothing, and here the women were naturally the most particular and extravagant. An Indian buying some cloth for a squaw was exactly the same spectacle as that of a civilized husband buying his wife a new hat. I used to sympathize with him and sometimes offered to measure the lady's head. If she really wanted the stuff she allowed me to measure her; if she did not she hurried up with a small bargain and hurried out. Some of the Indians seemed quite grateful.

Among the Stoneys.

The agent, missionary, policeman, clerk and two school teachers, together with the storekeeper and the railway staff, made up the whole population of the reserve. The Indian population is not great. There are about six hundred Indians, a few half-breeds—not many, for the Stoneys are a proud race. They were very kind to us and made our work possible, for as I do not know any Indian language I could not have got on without help.

My main purpose was the study of the physique of the Indians. The language difficulty and the fact that they had been in contact with the Whites for some time made any other work impossible; their old industries had vanished and most of the customs seemed to be fast dying out, so that an inquirer in these regions was seriously handicapped. Physically, however, there was no doubt that they did represent the old Indian type.

I expected to have some difficulty in securing measurements, and it proved to be a slow and tedious business, requiring much patience. I used to measure some of them after church in the schoolroom. This was usually a good time. On Sunday mornings the Indians used to ride or drive over the hills to church. Everybody, down to the tiny pappooses who jogged along tied in a bundle on their mother's or grandmother's back, was decked out in their Sunday best, and the bright colours of the blankets and the sunshine on the hills with their autumn colouring made a picture not easily forgotten.

Centre of Activity.

During the week I spent most of the working-day sitting on the counter in the store. Whenever an Indian came in I tried to persuade him to be measured. Eventually, except for a few conscientious objectors, I measured most of the men about the place and a few of the women. One day a very old lady came into the store; there was no one there to interpret, but she marched straight up to me and removed her head-dress and stood in front of me. She was very pleased when I brought out the callipers, and was one of the few who really asked to be measured, but at one time it became quite fashionable. A man who had a headache was measured, and he noticed that afterwards it disappeared, so then several minor ailments apparently demanded anthropological treatment—fortunately, for this helped to swell my numbers. I have often heard of headache being cured this way—indeed, it is my usual experience in field-work; but the Stoneys suggested a new train of thought when the old men and women said it made them feel younger!

At intervals of measuring we walked down to their villages or were motored over the reserve by the

agent in charge. The reserve is an area which is set apart entirely for the use of the Indians, a large number of reserves being maintained in Canada and the States for this purpose. The Stoneys chose this particular tract because it was a good hunting area ; unfortunately, the game is now getting reduced, and like so many hunting peoples they feel cramped. In exchange for the additional rights which they gave up they are paid annually five dollars a head treaty money, as it is called. They are also allowed certain rations by the Government, but do not always claim these.

Decline of Hunting.

The Stoney reserve is situated in the foothills of the Rockies, just where the mountains reach the prairies. It is bisected by the Bow River, a lovely ice-cold stream which here flows swiftly down from the Rockies to begin its long journey to the sea which it reaches at Hudson Bay. Along the gorge cut by the river the main C.P.R. line runs, the station on the reserve being about halfway between Banff and Cochrane (Alberta). Subsidiary streams have cut gullies down to the river and, as these tiny canyons and the edge of the main stream are clothed with spruces, while the more level terraces are open prairie, the general local conditions show considerable variety, no doubt greatly increasing the wild fauna in the old days. The Indians still do a certain amount of trapping in the autumn, but this, once their principal if not only occupation apart from war, plays a small part in their life. Although they are encouraged to cultivate fields they do not take easily to this, and at present only about fifty acres are cultivated. Cattle-keeping seems to be rather more suited to them. They possess numerous ponies and a number of cows, and even go so far as to cut grass for hay on the prairie. But even here they have not at present developed a local modern culture.

TYPICAL STONEY BOYS.

TWO LITTLE STONEY GIRLS.

Change to Ranching.

This point is of interest for comparative purposes. Down in the south-western States the Navajo, who inhabit the desert regions of Arizona, were originally hunters. Since the coming of the Whites they have acquired cattle and sheep, and to-day are typical pastoral nomads, who are singularly in equilibrium with their environment, and are apparently increasing fairly rapidly. The Navajo have been in contact with Western civilization for some time, and it is a question of interest whether the Stoneys will be able to develop some new culture in time to save themselves from extinction. It seems probable that pastoral pursuits rather than agriculture are most suited to them ; in any case, their old hunting culture becomes more and more impossible every year, and if they are to survive as a people they must find some substitute and work it out in their own way.

In the old days they lived in " tipis," easily moved and well suited to a hunting life. Within living memory they have been induced, very largely owing to missionary influence, to live in wooden shacks, the exact counterpart of that in which we lived. This is having a very bad effect on them. When their camps were continually being moved the absolute

lack of sanitation was no disadvantage ; to-day their villages are extremely dirty, a condition which seems to render them particularly subject to epidemics when they occur—they lost, for instance, nearly ten per cent of their numbers in the influenza epidemic of 1918, a particularly serious matter when the total number of the tribe is so small. In spite of the possession of these permanent shacks, most of the Indians still possess tipis, and tipi poles are to be seen in most of the villages, being used to hang skins on to dry, and so on. They are also used sometimes for travelling purposes, although the travelling of the Indians is limited to-day.

Ceremonial Gatherings.

It will be seen that the Indians have few occupations at present. About half of them, however, are usually off the reservation, and work on ranches and farms. The old ceremonies which played such an important part in their life in former days have vanished to a large extent. The sun-dance is, however, still performed every year. They erect a kind of large marquee of green boughs in a remote valley on the reserve, and the bare poles of this sun-dance lodge could be seen when we were there, but I did not like to photograph them in case I should hurt the Indian feelings. To a certain extent the old dances formed a means of recreation and their place has been taken by two things—the annual gatherings and story-telling which take place in the middle of the winter, and by " stampedes."

The stampede in its more organized form has become familiar to us in the rodeo at Wembley. These gatherings, which take place at intervals in the neighbourhood and on the reserve itself are eagerly looked forward to among the Indians. We went to one at Cochrane, about forty miles away. Most of the Stoneys attended. They drove—men, squaws and babies—in any old buggy they possessed ; they started out the night before and camped near the stampede crowd, and looked very picturesque in all their blankets. They compete freely with the Whites in the usual games—horse-racing, broncho-riding, steer-roping and riding, and so on. It is curious that the Indians on the whole are not so proficient as the Whites, but they are handicapped by not having such good horses.

I have often watched such stampedes among the Hopi in Arizona. There they were less organized. After a day's work gathering Indian corn they would rope a few horses and race or tackle an unbroken horse ; but the whole thing was very haphazard. It possessed, however, one trait, which is, I think, characteristically Indian, although it did not occur among the Stoneys—possibly owing to White organization—namely, comic relief. They ended the day or filled in a gap with a burro race (donkeys are always " burros " in the south-west), riders with their face to the tails or handicapped in some way. The same element usually appears in such dances as I have seen, though I saw none among the Stoneys. The dance is a solemn enough affair, but there is frequently a clown or bogey who makes people laugh by his fooling. Such a character, of course, is a frequent attendant at many folk dances, most of which have or had a religious character, which is still usually retained among the Indians.

It will be seen from the preceding paragraphs that little remains of the old customs or manner of life. But if White influence has changed the Indians' habits —at least, among the Stoneys— it has not changed the Indians themselves, who retain the magnificent physique possessed by their ancestors in the days when they used to hunt the buffalo on the plains. In order to understand the racial affinities of the Stoneys, it is necessary to consider their history for a moment. They belonged originally to that great group of Indians known as the Sioux. They separated from the mother stem a little before 1640, at which time they were living somewhere near the Lake of the Woods. Thirty years later they were living near Lake Winnipeg, having joined the Crees, with whom they have remained in close association from that day to this. Their whole history since the time that they first became known to the Whites has been one of continuous warfare, especially against their parent stock.

Analysis of Race.

It was to be expected that their physique would be closely approximated to that of the Plains Indians, and especially to the Siouan branch of those Indians. My figures amply confirmed this. Although they have separated from the Sioux for nearly three hundred years, and although during this time they have probably only intermarried amongst themselves and to a lesser degree with the Cree, it is impossible to distinguish them from the parent stock. This was to be expected, but further interesting results came out of the examination of my figures. East of the Plains Indians, living in the great woodlands of Canada which stretch from the prairies to the sea, there used to live—and a few do still live—tribes known as the Indians of the Eastern Woodlands, the most notable people belonging to Algonkian stock and including the well-known Iroquois and the Hurons. There can be little doubt that the Hurons and the people whose bodies were buried in graves which are usually

THE REAL "WILD-WEST."

considered to belong to ancient Iroquois are—or for the most part, alas, were—akin to the Indian inhabitants of the Eastern States and New England, the Indians with whom the Pilgrim Fathers and the early French and English trappers in Canada fought. These people have long narrow heads and are quite different from the Indians of the Plains. It seemed quite clear that we had in Canada east of the Rockies two different types of Indians. But I was surprised to find this summer that such was hardly the case.

Head Hunting.

In addition to working among the Stoneys I examined such skulls as I could in various collections, and Sir Francis Knowles, who was formerly in the service of the geological survey of Canada, lent me his notes on the Iroquois. I found there were two groups, it is true, but quite different from what I had expected. Knowles' modern Iroquois were of exactly the same physical type as my Stoneys. The skulls which I was able to examine in central Canada also had clearly belonged to the same physical type. But the ancient Iroquois were quite different and belonged to the same race as the Indians of New England. Clearly then at one time, and that probably not very remote, the physical type which we usually associate with the Indians of the Plains must have overrun most of eastern Canada, taking with them merely their physical form—not their culture, for the woodland culture is quite different. The few modern surviving Indians seem to belong to this physical type, although in the east it is much altered by White admixture. At present there is little evidence for eastern Canada, but I am hoping that either I, or someone else, will go into the woodlands between the Canadian Northern Railway and the southern shores of Hudson Bay and report on the type to be found there. It may prove to be either the relics of people akin to the old Iroquois, and this is, I think, very probable, as many relics of broken tribes seem to have migrated to Canada; or they may be of the same physique as the Stoneys and the unknown former owners of the skulls from central Canada.

Assorted Skulls.

Searching for skulls to measure was an occupation which had its amusing side. When you come to look into the matter it is quite extraordinary what a number of people have odd skulls about the place. I found a number in a museum in Winnipeg—that was natural enough. Then I found some more in the Hudson Bay Company's store. I did not expect them there, but the manager told me that some years ago he had bought a collection of "Indian relics." These included, besides some beautiful bead work, some skulls and four volumes of sermons—the anthropologist meets with specimens in quaint company! Emboldened by this success I asked the owner of the principal store in Banff whether he had any Indian skulls. To my surprise he had acquired some in a similar way, but in this case he knew exactly where they had come from. His brother, who ought really to have been a scientist, dated one of the skulls exactly. The man had been killed in an intertribal skirmish by a particular kind of bullet. My informant spotted

INDIAN CHILDREN ON THE RESERVATION.

this and knew exactly when these bullets had been used by the Indians; it was one of unusual calibre. So I had the skull dated by exact archaeological evidence.

Camera Troubles.

All the particulars I have given above were deduced from the skulls which I was able to examine by these quaint chances, and I still marvel at the curious fate which led me to discover so many valuable scientific specimens in such curious places. In one thing fate was unkind. I had hoped to get photographs of Indians in addition to my measurements. On certain occasions this is not difficult, especially at a stampede, but during the only big stampede we went to it rained the whole time and I could get no portraits. On the reserve they refused absolutely to be taken. They faced my callipers with equanimity, but not my camera; so, alas, I had to be content with pictures of the children, who did not seem to mind.

This, then, was the sum of a short season's work: plenty of observations on the manner of life of the Indians, a fair number of measurements on the living, and about the same number on chance-found skulls. We were very sorry to leave the reserve, and we left it with a feeling of wonder as to what will be the ultimate fate of these descendants of the old fighting Sioux. They are now surrounded by civilization on every side. I do not think that there is any reason really to believe that their numbers are actually decreasing; indeed, they have increased in the last thirty years. One of their greatest dangers are epidemics; a smallpox attack in 1836 killed half their numbers, in 1918 they lost about 60, a very serious loss when the whole tribe only numbers 600. Since they have been living in shacks they have suffered much from tuberculosis, but they are surviving that scourge. There is good reason, therefore, to think that they will survive.

Future of the Tribe.

What then is to be their future? It is clear that at present there is but a small chance of our successfully grafting our civilization upon them, for a long period of evolution cannot be bridged in a day. It seems most probable that they will borrow elements of our culture and transform it to their uses, and so evolve a place for themselves in the world. Our civilization may be said to be founded on agriculture, and many Indian tribes had reached this stage before the discovery of America. I have shown, however, that the Stoneys seem to take hardly to agriculture at present, and it seems probable that for the immediate future it is most likely that they will find their vocation in pastoral nomadism, in the keeping of cattle and herds, and that by this means they will secure for themselves a right to survive and to continue to exist as a people.

GRAVEL IN GIZZARDS.

THE occurrence of grit or gravel in the gizzards of poultry is known to every cook in practice, and in theory to zoologists. Recent researches carried out on fowls fed on grit-free food and kept in grit-free cages show that the original supply of grit in the gizzard is sufficient for a year's use. No variation from the normal average of grit content was noted in fowls kept under these test conditions and killed at intervals of a month throughout the year. Similar tests showed that edged grit or rounded grit was of equal value so far as poultry were concerned.

WEIGHT OF SHEEP INCREASED BY BASIC SLAG FERTILIZER.

DR. VANSTONE, M.Sc., F.I.C., in a lecture said that the results of his experiments at Newton Abbott with basic slag showed that this was an excellent fertilizer for grasslands, since sheep and cattle grazed on the and increased in live weight. The quantity and quality of the milk also increased, whilst the weight of the hay increased by 10 cwt. per acre. In addition, the fertility of the soil was improved and showed further improvement for each successive year that basic slag was used.

DO CHICKENS MAKE THEIR OWN VITAMIN-C?

FOWLS were kept for some months on a diet containing no Vitamin-C, the vitamin that prevents scurvy. They appeared quite normal and to feel no lack of proper nourishment. In addition on killing them and feeding their livers to guinea-pigs who had developed the usual debility produced by a Vitamin-C deficient diet, these latter recovered and became quite unaffected by the lack of Vitamin-C in their food. It appears possible, therefore, that the fowls' livers contained plenty of Vitamin-C. This suggests that a liking for pâte-de-foie-gras may, after all, be only the outward sign of a need for Vitamin-C.

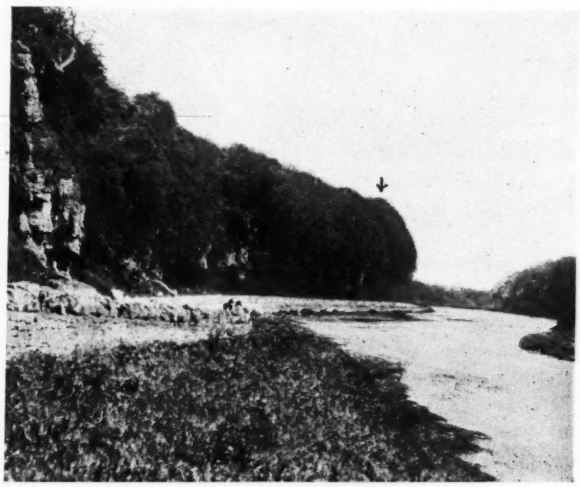
The Cave Dwellers of Creswell Crags. A Record of Recent Excavations.

By A. Leslie Armstrong, M.C., F.S.A.

The Creswell Caves are developing into one of the most important prehistoric sites in Great Britain. This is because the deposits show a most interesting sequence of successive cultures and occupations and suggest Magdalenian influence, possibly even Magdalenian occupation. Further discoveries may throw light upon many points of British pre-history. Readers of "Discovery" will be kept informed of future developments and discoveries.

ARCHAEOLOGY is always a fascinating study, but of its many phases none, I think, can be more absorbing than that of prehistory and the endeavour to discover, piece together and interpret the hidden things relative to man's early history, and to construct therefrom an ordered connected story of his life in the long forgotten past. When the purpose is to disentangle the threads indicating his presence here in Britain, the quest becomes doubly interesting.

Such is the object of the joint Committee of the British Association and Royal Anthropological Institute in undertaking systematic researches amidst the caves and rock shelters of Derbyshire, and whose efforts have already been rewarded by important discoveries particularly in the Creswell Gorge, on the borders of Derbyshire and Nottinghamshire.



CRESWELL CRAGS.
The Mother Grundy's Parlour rock-shelter is denoted by the arrow.

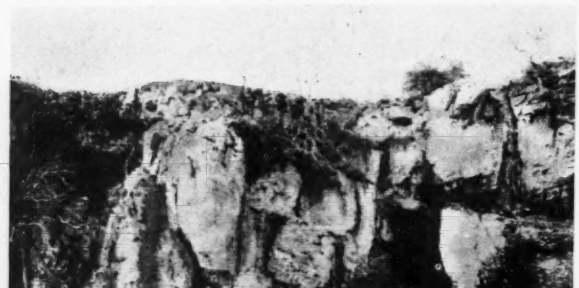
Situated in the midst of a small area believed to have been left untouched by the ice which in the later glaciations seems to have skirted its borders east, west and south, and with the country northwards submerged beneath glaciers and glacial lakes, the sheltered ravine of Creswell would provide an ideal retreat alike for man and beast during the slow oncoming and recession of the encircling ice-fields. Though scarcely a quarter of a mile in length the narrow gorge with its lofty overhanging cliffs of Permian limestone, the five caves and countless fissures and tunnels, afforded to man and carnivorous animals shelter and safe asylum through an immensely long period of time and many fluctuations of climate. That they had actually been so occupied, and that the nomadic hunters of the Old Stone Age had disputed possession of the caves with the hyaena, lion and cave-bear, was abundantly proved fifty years ago by the excavations of Sir Wm. Boyd Dawkins and his colleague, the late Rev. J. M. Mello. They traced three distinct periods of occupation, and attributed them to Acheulean, Mousterian and Magdalenian times.

It is unfortunate that the story of Creswell cannot be told without using these and similar ponderous terms, of which prehistoric archaeology, in defining its stages and sub-divisions, uses more than its share.

Milestones.

To the uninitiated many of these are meaningless. In reality they constitute milestones down the long, long trail of time denoting successive phases in man's early history, and mark out the track of racial movements which probably affected the history and progress of Britain and Europe as profoundly as did the incursions of Roman or Goth in historic times. Briefly, the stages and definitions are as follows :—

The extremely long Palaeolithic, or Old Stone Age period, is divided into a Lower and an Upper division. The Lower Palaeolithic is again subdivided into three stages—(1) Pre-Chellean, (2) Chellean, and (3) Acheulean, named respectively after Chelles, near Paris, and St. Acheul, near Amiens, the French sites at which the type implements were found. Intensive digging by French archaeologists has enabled them to split the Upper Palaeolithic into stages characterized by the pattern and workmanship of the



THE PINHOLE CAVES AT CRESWELL CRAGS NOW IN COURSE OF EXCAVATION.

tools used. Each stage or "milestone" was given the name of the cave, or site, where the typical examples were first recognized, and are six in number, viz. :— (1) Mousterian the lowest and most primitive, followed by (2) Aurignacian, (3) Solutrean, (4) Magdalenian, (5) Azilian, (6) Tardenoisian. Stages 1 to 4 are the true cave periods, 5 and 6 the periods during which a transition to Neolithic becomes apparent. The typical stations which have given their names to these stages are the rock-shelter of Le Moustier, the cave of Aurignac, the rock-shelters of Solutre and La Madeleine, the cave of Mas d'Azil and the area around Tardenois, in France.

The Spread of Culture.

It is now recognized that the appearance in a deposit of a new fashion in tools and technique is attributable to the intrusion of outside influence either by invasion, or through the mingling of people or tribes possessed of a different culture, and that the degree of dominance attained by the new culture usually defines the means of its introduction.

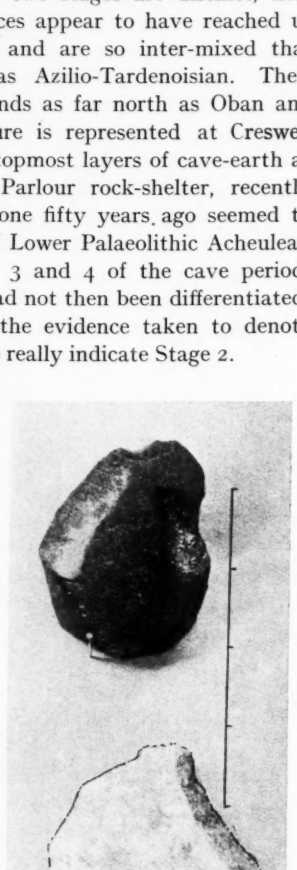
Thus in early post-glacial times Cro Magnon man, with his Aurignacian culture (Stage 2), appears to have driven out or destroyed the remnants of Neanderthal Man and the Mousterian culture (Stage 1), and to have become dominant for a long period over most of southern Europe and also in England as far north as Creswell. This extensive primitive civilization was later disturbed here and there by the penetrations of a migrating people, the Solutreans of Stage 3, who were probably of different race, certainly possessed of a different culture and more skilful in the working of flint. They appear to have entered Europe from the East, and ripples of their influence were felt in various parts of England, including Creswell. Stage 4, Magdalenian, marks a similar incursion which profoundly affected Central France and was more wide spreading and continuous than the Solutrean. Whether or not this extended to Britain has of late been disputed, and constitutes one of the culture problems which the present excavations at Creswell may materially help to elucidate. Recent work in the Pin Hole Cave has brought to light an important implement in mammoth ivory, engraved with a conventional pattern on one side, which is of classic Magdalenian design and workmanship and is conclusive evidence of Magdalenian influence, but that Magdalenian people lived there has yet to be established.

Stages 5 and 6, the Azilian and Tardenoisian, are cultures which appear to have originated in North Africa. In France the two stages are distinct, here in Britain both influences appear to have reached us about the same time, and are so inter-mixed that they are spoken of as Azilio-Tardenoisian. Their range of influence extends as far north as Oban and Dundee, and the culture is represented at Creswell by the contents of the topmost layers of cave-earth at the Mother Grundy's Parlour rock-shelter, recently explored. The work done fifty years ago seemed to indicate the presence of Lower Palaeolithic Acheulean man, also of Stages 1, 3 and 4 of the cave period. Stage 2, Aurignacian, had not then been differentiated, consequently much of the evidence taken to denote Stage 4 is now known to really indicate Stage 2.

Object of Recent Research.

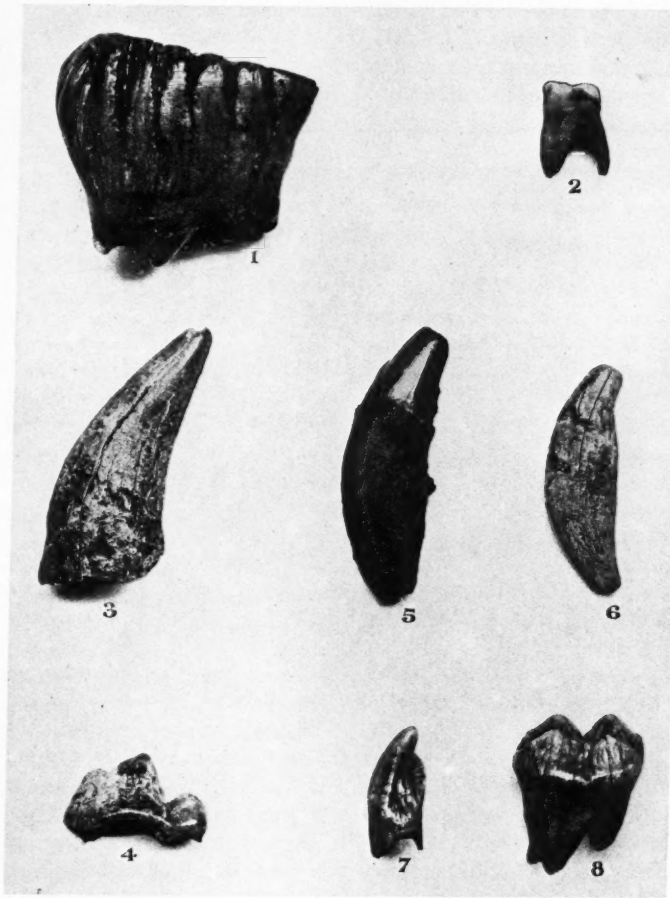
It was with a view to defining more exactly the series and sequence of cultures represented in this the most northerly station of Palaeolithic man in England and, if possible, discovering skeletal remains which would denote the race of the cave-dwellers, that work was undertaken at Creswell in 1923.

In research of this nature the "beau-ideal" is to discover a site which in successive generations had been used as a



QUARTZITE IMPLEMENTS.
From the lowest layer of Mother Grundy's Parlour and Pinhole Cave.

camping ground or home and where the resulting deposits remain *in situ*. Of these, caves and patches of level ground protected by over hanging rocks, termed rock-shelters, and by preference facing south, invariably prove the most prolific. The Creswell ravine runs east and west, and the sunny side is plentifully supplied with caves and rock-shelters but, unfortunately, unskilled excavators have left few inviolate, and a deposit once turned over becomes valueless for scientific purposes. Disturbance is not always due to man, frequently rabbits and badgers are responsible, and the writer has known such to introduce into a Palaeolithic stratum a sardine tin, broken beer-bottles and similar exciting relics. At times they are more friendly, however, and their activities lead to the discovery of occupation areas or hidden caves, as in the case of Victoria Cave, Settle, which was revealed by the presence of rabbit burrows at the base of the cliff. The first season's work at Creswell was not very encouraging, but the persistent digging of trial holes in situations which, to-day, offer shelter from the cold winds and are such as one would personally select for an encampment were the ravine infested by beasts of prey, finally resulted in the discovery of three living sites, sections of which revealed definite layers of stratification denoted by bands of black carbonaceous earth and the presence of charcoal and flakes of flint. Two of these rock-shelters still await excavation and as in one instance the trial hole showed five super-imposed layers, each separated by a stratum of light-coloured sandy earth representing intervals in the occupation; when it is excavated interesting finds are anticipated.



1. Tooth of baby mammoth. 2. Human tooth. 3 and 4. Lion teeth. 5. Hyaena. 6. Wolf. 7 and 8. Bear.

Excavations in Progress.

All the caves of the ravine were believed to have been entirely dug out, but a careful examination of the Pinhole Cave, the first of the Creswell series in which any digging was done, and where Mellos' original discoveries were made in 1874, has unexpectedly proved that the deposits in this extensive cave remain practically intact, only the front portion having been dug by Mello. Work is steadily progressing there, and has already yielded valuable results, an account of which will be given in a subsequent article. Excavations are also again in progress upon the important rock-shelter site partially explored last season. This is situated in the forefront of Mother Grundy's Parlour, a cave explored many years ago but, fortunately, the excavators did not deem the platform in front of the cave worth examining! It has proved one of the richest and most interesting sites in England, an area ten feet square having yielded over 1,500 pieces of flint, many of which are exquisitely finished implements, also tools of reindeer antler and three fragments of engraved bone. Successive generations of cave-folk had used it as a periodic encampment so long that the floor had been raised three feet by the debris of countless fires and feasts and the slow destruction,

by rain and frost, of the overhanging rock which sheltered it.

In exploring such a site the first objective is to ascertain the depth and stratification of the deposit. A trench, about four feet long, is carefully dug until the bed-rock of the cave is reached, or a stratum unmistakably sterile of human and animal relics.

Excavation Methods.

Every particle of earth removed is passed through a small mesh riddle and all stones are carefully examined for drawings, grooves or artificial hollows. Vertical sides to the trial trench are essential, and if these are dressed the layers of stratification are, as a rule, readily detected. A drawing of the section is next made and the position and thickness of the layers recorded for future reference. A definition of the superficial extent of the site is desirable, and a plan upon which the progress of the work and position of the finds can be recorded is an absolute necessity.

PALAEOLITHIC FIREPLACE
at the base of the Mother Grundy's Parlour rock-shelter. The crosses mark the flanking stones of the fireplace.

It is very desirable that the actual work of excavation should, wherever possible, be done by a trained observer—not by workmen—and to attain the most reliable results and most valuable records, the same individuals should carry out the work from start to finish. The method of examination varies according to circumstances and the nature of the section. At Mother Grundy's Parlour it consists of a closely-compacted mass of cave-earth and stones, and the work is being done in a series of vertical slices about three feet long and one foot broad and the full depth of the deposit. The slices are examined in horizontal layers as nearly as possible six inches in thickness. All the earth is sieved and the flints and other objects as they are recovered are marked in pencil with their respective depth and position, and descriptive notes made in the field notebook. Each class of relic is placed in a separate tin or bag for removal. Afterwards they are washed and permanently marked.

A comparison of the stone implements found at the base of the section with implements found in the Pin-hole Cave recently, shows that the earliest occupants of this rock-shelter were Mousterian men (Stage 1), who manufactured rude tools from quartzite pebbles and were companions of the cave lion, mammoth and rhinoceros, as testified by the bones recovered. Probably they lived here during the oncoming of the Wurmian glaciation and the rigours of this final glacial epoch drove them out. When after a lapse of thousands of years the site was again occupied it was by Aurignacian man (Stage 2), a cunning hunter, much more advanced in culture, a skilful flint worker, and an artist who executed drawings on bone and ivory and manufactured beautiful tools in reindeer antler and bone.

Glaciers still dominated the country to the north, winters were severe and summers hot. The reindeer, mammoth and woolly rhinoceros were common in the district and fell a prey to the great cave hyaenas and wolves as well as to man. At the base of the deposit a fireplace was found formed in a hollow scooped in the basement bed and surrounded by stones on edge which was the work of these early hunters. The presence around it of bear and hyaena teeth, mammoth ivory and split and charred bones of horse, reindeer and bison, clearly show what their companions were and what animals they hunted. Horse and bison were their staple diet, and in the ashes of the fire marrow bones were roasted and afterwards split by stone pounders. Probably the flesh was cooked by grilling, much as primitive people cook it to-day, and by the use of heated stones, of which innumerable broken fragments lay around the hearth shattered by heating and re-heating. No pottery was found, most likely they were unaware of its use; it is extremely rare on a Palaeolithic site, but an implement used for piercing the eye of bone needles indicates that these people were familiar with the art of sewing. That they had considerable artistic ability and were skilful workers in bone and ivory the engraved bones and the bone tools testify.

History Written in Stone.

The whole thickness of this interesting deposit told a similar story. Fires had been lighted on the same

spot through the ages. The gradual disappearance of reindeer remains and the predominance of those of horse and bison tell of a change in climatic conditions from sub-arctic to temperate. Near the top of the deposit the bison disappears and a more familiar fauna is present, including boar and red-deer.

The flint implements gradually, almost imperceptibly, change from Aurignacian forms at the base to typical Azilio-Tardenoisian forms in the upper layer, including examples of the fascinating little pygmy burins, five of which will lie together upon a sixpence, the use of which is difficult to conceive. Though the lowest level is, in view of evidence derived from the Pinhole Cave, contemporary in time with the Magdalenian culture of France, there is no trace of intrusive Magdalenian elements in this Mother Grundy's Parlour culture, but a gradual development from Aurignacian to Azilio-Tardenoisian, and it appears probable that as further research is carried out in other parts of the country, this may prove typical of the development of Upper Palaeolithic culture in England as a whole.

NOTE.

Further descriptions of the progress of the excavation will be published from time to time in DISCOVERY.

THE VALUE OF CHANGE.

(Continued from page 257.)

to find so rare a bird. Even if the prescription failed it would at least remove from the physician's neighbourhood the all too obvious evidence of unsuccessful treatment.

Experience seems to show that successful resistance to infection is bound up with the normal reactions of the body to the stimulus of adverse conditions, so that the old treatment by counter-irritation was neither illogical nor inefficacious. Blisters, setons and acupuncture have now gone out of fashion, but their place has been taken by the more specialized and controllable counter-irritation of vaccines and ultra-violet light.

The stimulus of adverse conditions is known also to affect fertility. It has been observed that the lower organisms, especially plants, react to adverse conditions by increased reproduction, a reaction that would make for the survival of the species by producing a large number of young and probably varied individuals. An equable environment, on the other hand, may be one of the factors which cause the low fertility among the leisured classes. It may be noted that beating with young twigs is a widespread practice in the magic rites by which uncivilized races seek to promote the fertility of their community, and perhaps a trace of this custom survives in the rough horseplay of the carnival.

The necessity of change is not absolute, for many people seem to thrive in equable conditions, and against the cult of the rough and strenuous life must be set a growing tendency to take exercise vicariously by watching games and to enjoy emotional experience by the aid of the imagination and the cinema. But if we get a measure of the value of change to ourselves it is an easy matter to secure what we need without denouncing civilization as an unmitigated evil and following Thoreau into the woods.

VITAL STATISTICS FOR 1924.

THE Registrar-General has just issued his corrected vital statistics for England and Wales for 1924. The figures are as follows :—

There were 730,286 births and 473,270 deaths. The natural increase of population by excess of births over deaths was therefore 257,016, the annual average increase in the preceding five years having been 335,352.

The number of persons married during the year was 592,048.

The marriage rate was 15.3 per 1,000 population. The birth rate was 18.8 per 1,000, and the death rate 12.2 per 1,000. Infant mortality was 75 per 1,000 registered births. The birth rate was the lowest recorded except during 1917-19 ; the death rate was 0.6 per 1,000 above the rate for 1923 ; the infant death rate was 6 per 1,000 births above the 1923 rate.

The " killing " diseases, so far as London is concerned, appear in the following order, which is practically the same as that of 1923, except that, owing to the presence of influenza in 1924, the respiratory disease group dominates the heart disease group :—

No.	Diseases, etc.	No. of deaths.
1.	Respiratory diseases	10,620
2.	Heart diseases	10,191
3.	Cancer	6,427
4.	Tuberculosis (" consumption ") ...	4,362
5.	Digestive disease	3,064
6.	Apoplexy	2,606
7.	Old age	1,886
8.	Influenza	1,663
9.	Deaths from violence	1,563
10.	Bright's disease	1,387
11.	Measles	1,335

The Death-watch and Furniture Beetles.

The very serious ravages committed by the Death-watch Beetle threatens some of the finest wood roofs in England. Public attention is directed to the danger and where it is recognized in time it can be defeated. In a lesser degree the furniture beetle threatens beautiful old woodwork. Methods of dealing with it are outlined in the pamphlets reviewed in this article.

Two important pamphlets have been issued recently—one is from the Society of Antiquaries, the other from the British Museum (Natural History). The first deals solely with the Death-watch Beetle, the second is "Furniture Beetles and how to check or prevent the damage caused by the Worm," by Charles T. Gahan, D.Sc., Keeper of the Department of Entomology. It also covers the Death-watch Beetle. This second pamphlet (price 6*d*. net) should be in the hands of everybody with a nice old country house, old furniture, and the inevitable worm. It gives sufficient information for anyone whose gear is suffering from worm attack to be able to get a local microscopist to identify the raider and the local chemist to make up a suitable gas attack mixture. It would perhaps have been better if clearer prescriptions for household use had been incorporated. A good deal is said about the utility of the vapour of benzene. If you go to a chemist's shop for it a small two-ounce bottle costs a shilling, and if you to to the garage and ask for benzole you get the same thing for all practical purposes at about four shillings and sixpence for a two-gallon tin. You can treat a floor or joists with benzole on an economical basis where benzene would be prohibitive. The pamphlet is extraordinarily good, but it does not perhaps quite get down to the practical issue. What people really want to know is this: "Go to the chemist's and get a five-shilling hypodermic syringe; get a tin of benzole from the garage; take the worm-eaten piece of furniture out on to the lawn; don't smoke or you will be burnt to death. Now start and squirt benzole down each hole in succession, letting it drain in as much as possible. If it is a varnished piece remember that benzole dissolves varnish, so if it overflows wipe it off with a rag at once. If it is a small thing like a tea caddy put in it a box with saucers of benzole and let the gas soak into it."

The Society of Antiquaries goes in for larger affairs than mere furniture. They are interested in the preservation of old buildings, and the Death-watch Beetle is the enemy of both Church and State. The pamphlet which we reproduce is written by Professor Lefroy. It gives valuable advice to all those interested in affected buildings. Those requiring advice on furniture beetles should acquire the pamphlet published by the British Museum.

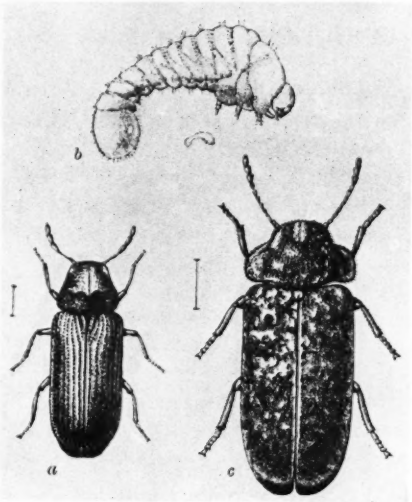
The discovery that the Death-watch Beetle had attacked the roof timbers of St. Paul's Cathedral and Westminster Hall led to further investigation, and it has been found that nearly all buildings in which oak has been used for roof timbers, flooring, screens, and similar internal structures are now, or have been, infested with the beetle known as the Death-watch, whose grub eats tunnels in the solid wood, gradually destroying it. Deal is also attacked when in contact with oak, the grubs working through from the oak to the deal. But the attack on deal never becomes serious since the grubs, as they become mature, tunnel to the outside of the deal, where they become beetles and these beetles do not again attack the deal. Therefore, in treating the oak, it is as a rule possible to treat the deal in contact with it.

Oak Mainly Affected.

Unfortunately, there is good reason to fear that the grub is at work in the great majority of buildings in which oak has been used: in one case an oak floor put down in 1882 has already so perished as to be useless; there are a few definite cases in which attack has occurred probably a century or more ago and has ceased because the grubs have devoured all the suitable wood and, as they became beetles, have migrated elsewhere. In such cases, if no serious structural damage has occurred, nothing need be done, and the main object of this leaflet is to point out how the present condition of any oak roof or structure can be ascertained, so that either it can with confidence be left untouched or, if the attack be in an early stage, be treated at small cost.

The attack of the beetle will be found specially in places which are ill-ventilated: wall-plates, purlins, the ends of principal or common rafters in walls are likely places, as also are spots where a number of timbers come together; the open well-ventilated tie-beams or hammer-beams are not so likely to be attacked unless they are very large.

It is important to look for any wood added during restoration or repair, as so many buildings have been attacked in this way, and if there is a definite record



(*a*) Furniture beetle, *Anobium Punctatum* (Segeor); (*b*) Its larva (*c*) The Death-watch Beetle *Xestobiums rufovillosum* (Segeor).
(*From Furniture Beetles, Gahan*)

of restoration or repair in oak during the last century it is almost certain that attack will now be in progress.

Two beetles commonly attack wood in buildings; both emerge from the wood when they become beetles, and the nature of the beetle may be recognized by the size of the hole through which it emerges. The larger hole, shown exactly here, is that of the Death-watch; the smaller is that of the Furniture Beetle. The latter is of no importance in oak, though it may be found in sapwood at the edge of timber. It is common in deal and similar soft woods, but rarely goes so far as to render a timber unsafe.

Identifying the Holes.

If the larger holes are found they should be examined carefully to see if they are fresh and clean-cut; if so, they may be recent and active attack may be expected to be in progress; but if they are of the same colour as the surface, with dirty edges, they are probably old and not significant of present attack. Of course, in long-standing attack both will be found.

A second point to look for is the characteristic oval buff-coloured pellets which are the excreta of the grubs. If these are continually falling, or if fresh heaps of them are found below fresh holes, it may be anticipated that attack is in progress. Several cases of inaccessible roofs have become suspect on account of the constant dropping of these pellets, and examination has shown them to be attacked now. These are absolutely diagnostic of this grub.

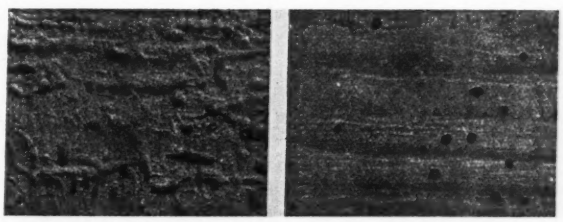
Life Cycle.

The facts of the beetle's life may be very shortly told: As beetles they emerge in May or June, whether from dying oak trees in the open or from building timbers. Before mating, they make the characteristic tapping sound that gave them their name. The female lays eggs, up to about eighty, in cracks, crevices, or open surfaces; from these come grubs that seek a tiny crack whereby they may burrow in; for at least that summer and two more they feed on the wood, making extensive honeycomb tunnels. Then, late in the third summer, they tunnel out to very near the surface and become the chrysalis. From this, in the same autumn, develops the beetle which normally only leaves the wood next spring, though if the building is warmed it may emerge earlier.

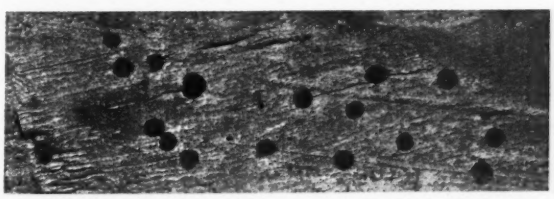
There is, therefore, a three-year cycle, and active beetles are found outside the timber usually in May and June.

The beetle can fly. In one church, where it was very abundant, it became a nuisance to worshippers. As a rule it does not come down from roof timbers.

Those in charge of buildings liable to attack may be alarmed by the vast sum spent on Westminster



Worm holes in deal flooring in plan and section (natural size).



Surface of an old oak beam showing exit holes of the Death-watch Beetle (natural size). Compare these with the ordinary furniture beetle holes shown above.

Hall, but this was due to the necessity of reconstruction in steel as a basis for the replacement of the old oak, a method not ordinarily necessary. Unless actual

structural repair is required, a building can be treated chemically and at moderate cost, with little disturbance except the uncovering of wall plates and the ends of principals. The basis of the treatment is the application, by means of a spraying-machine, of a liquid that thoroughly wets the timbers, penetrates any decayed parts, enters any beetle holes, gives off a vapour that destroys the grubs inside and leaves behind an invisible unalterable film of poison which kills emerging beetles or kills grubs seeking to enter. Such a fluid, applied with a proper sprayer, will cover twenty to thirty square yards per gallon. An ordinary church roof may be treated in a day unless structural alteration is required, and the total cost may not exceed fifty pounds. A serious item, of course, is the scaffolding to reach the timbers.

This method has now been in use for over ten years, and a fluid has to be selected according to the conditions of the wood itself, whether it be varnished or painted or has the natural surface. Such liquids must, of course, be non-poisonous, non-inflammable and not irritant. There are at least five such liquids obtainable from reputable firms, at a cost varying from ten shillings per gallon upward.

These details are given to show that the cost of treating an ordinary parish church or ancient building is reasonable and not excessive. Those who have not seen a roof sprayed cannot realize how quickly and completely a wood roof can be treated provided access to it is possible, and in most cases the removal of the outer covering is not necessary.

It is important to emphasize the care that must be taken in any repairs or restoration in which oak is used, whether it be sound seasoned new oak or old oak from another building. All such should be chemically treated when it has been finally shaped ready to be put in position and after it has been put in.

Had the facts of the beetles' activities been known and the chemical treatment been available when so many buildings were repaired or restored during the last century, there would not now be the many cases of attacked roofs.

H. M. LEFROY.

BIBLIOGRAPHY.

Derham: *Phil. Trans.* (Royal Society), xxii (1701), 832 xxiv (1704), 1586.

C. J. Gahan: "Furniture Beetles," British Museum (Natural History), 2nd edition, 1925. *6d.*

Sir F. Baines: "Report on the Roof of Westminster Hall." Cd. paper No. 7436, 1914.

(The society desires in this leaflet to emphasize two points: first that it is possible to ascertain if a building is attacked; fresh emergence holes, fresh pellets are danger signals; secondly, that treatment is not usually expensive or difficult, unless matters have gone so far as to necessitate structural repairs. In doubtful cases the society is able to offer advice if specimens are sent by post and, within certain limits, would advise on special cases if full particulars are available as to the structure. All communications should be addressed to the Assistant Secretary, Society of Antiquaries, Burlington House, Piccadilly, London, W.1, from whom copies of this pamphlet may be obtained gratis on application.)

YAJEINE.

A NEW drug that has been recently brought to this country for chemical examination is called by the natives of the Colombian territories of the Putumayo and Caqueta rivers, where it grows, by the peculiar name of "Yaje." The drug is prepared from the stem of a rather leafless shrub which averages about nine to twelve feet high. What leaves there are are counterpoised and a dark olive green in colour. The infusion made from the stem by heating in water is reddish with greenish fluorescence, and on keeping this changes to a topaz having a beautiful bluish-green fluorescence. Under the influence of the drink the natives jump, scream, and run wildly about making a great uproar. Accordingly it is highly prized for use on ceremonial occasions, fresh potations being taken as the effects of the preceding ones wear off. According to Professor Villalba, who has investigated it, the infusion contains two alkaloids that may be readily crystallized; one, the more important, he has named "Yajeine," and the secondary one Yajenine. Experiments upon guinea pigs show that the toxic dose is about 0·2 gm. per kgm. body weight. In small doses it gives human beings a deep sleep and a sensation of well-being.

NICOTINE AND THE TOBACCO PLANT.

ALTHOUGH nicotine is used so extensively to-day in nicotine-soap washes, to combat insect pests such as aphides and so on, it appears to have no protective action when actually present in the growing tobacco plant. Experiments showed that aphides, eelworms and bacteria thrived on growing tobacco plants, despite the nicotine present in leaves and stems. It is thought that the nicotine is only a storage product of the plant, and is not produced as a protective agent.

Telepathy and Clairvoyance.

By Rudolf Tischner with an introduction by E. J. Dingwall.

The reality of telepathy is not yet scientifically accepted or proven, but remains a borderline subject. Serious research work has been done recently and this book embodies the author's views of the results.

PROFESSOR TISCHNER'S "Telepathy and Clairvoyance"* is quite the most important book that has yet appeared on these subjects. The author describes most carefully a series of experiments performed under strict test conditions. These he divides into two categories, those which can be explained by a hypothesis of telepathic communication, and those that require some other form of experience or contact to explain them. The latter cases are, of course, the most interesting, since the purely telepathic are in every way similar to those which have previously been reported and substantiated. The cases of clairvoyance are divided into two classes—cryptoscopic and psychoscopic.

The first consist in the discovery of the nature of something hidden in a package or written on a folded paper; the latter in the divining of incidents connected with the history of a given object—which latter used to be called psychometric. Both postulate a type of experience which, if substantiated completely, refutes the materialistic explanations of existence.

No Explanation.

The third chapter of Professor Tischner's book deals with the theory of telepathy and clairvoyance. The first point that he makes is that neither phenomenon is a physical action of the brain transmitting and receiving rays of light or sound. As an explanation of telepathy the loose comparison of these phenomena to wireless is valueless, since we cannot find any organ in the body that could be used for transmitting or receiving. The ordinary kinds of physical energy do not afford a satisfactory explanation. Some form of psychic energy must be assumed if any form of energy is to be postulated. But by postulating even a psychic energy connected with the ganglion cells we must offer an explanation of how it is transformed from ordinary physical energy, transmitted, received and reconverted into conceptions. The difficulties are insuperable. If, however, we postulate that psychic energy is free, the ideas transmitted are themselves energy, so we must admit they are transmitted as such, not that they are bound up with some physical vibration. That is, we must contend that a psychic *something* exists quite apart from our bodies, with a free existence of its own. This leads to difficulties. Does the synthesis of ideas travel unaltered as a whole through space and how is it built up? The theory of a psycho-physical energy as an explanation of clairvoyance is even less feasible. The perception of an object does not take place through the eyes or through any organ similar to them, since in various of Dr. Tischner's cases the medium reads a slip of paper folded several times so that the writing would be on several geometrical planes. These cases in particular weigh against any physical explanation of cryptoscopic phenomena, such as the hypothesis of "eyeless sight" which has received much attention of late. Any physical explanation that could be put forward for psychoscopic cases would be even more lame. Unless we are to dismiss these as telepathic, which certain cases analysed in this book forbid our doing, we must assume a non-physical explanation. We are consequently led to consider the possibility of the action of the mind outside the body; this is the psychical theory; on this hypothesis we can easily explain telepathy as the action of the brain of the agent on the non-physical mind of the recipient. This theory, of course, does not explain clairvoyance; here Dr. Tischner calls to his aid Einstein's theory of relativity as applied to space and time. He insists that a rational explanation is possible, and hints at a theory of a super-individual mind.

Dr. Tischner's book is of great importance to all thinking people, and we cannot give too much praise to the dispassionate and scientific spirit in which the author and his friends conducted their experiments. The next few years should lead us to reconsider our opinions on occult subjects and without going to superstitious extremes we may discover logical explanations of unexplained phenomena, and thereby learn something more of man's place in relation to the super-physical. Dr. Tischner's book should do more than a little to further our interest in this and, without entirely accepting all his views, we can welcome further investigation on these lines of research which afford little handle for those who would exploit occultism and psychical research for profit.

* Kegan Paul, 10/6 net.

Book Reviews.

Among Wild Tribes of the Amazons. By CHARLES W. DOMVILLE-FIFE. (Seeley Service. 21*s.* net).

There is a particular quality about this book which makes it not only one of the most readable books of exploration and travel but a book of real educative value. It has balance and shrewdness. Not only does one feel that the author really knows the country as a close student and observer, but further that his conclusions are sound and not simply hasty generalizations. It is a book which should be read by all would-be explorers or all whose work may fall in little known parts of the earth, for it is an excellent model of what an exploration book should be. There is the right proportion of clear, accurate description which enables the reader to visualize the unknown land, and the right proportion of the personal equation which gives it a live-gripping interest throughout.

Readers of DISCOVERY are already familiar with some of the difficulties of exploration in the heart of South America, and the fact that vast areas are still unmapped, unexplored and unknown. It is not until one reads Mr. Domville-Fife's book that one realizes the why of this. There are difficulties and dangers—cannibal tribes, impenetrable jungles, mazy lagoons, and uncharted waterways—which make systematic large-scale expeditions well-nigh impossible. The explorer has no easy task before him if he is really intent on reaching new land. It is true that one can touch the fringe of the unknown on a six weeks' trip, but real work means months of jungle hazard and fever and nature are greater enemies than even the sullen Indians.

South America is almost untouched country for the ethnologist and the scientific research worker. Mr. Fife's book is the standard work, and the author stresses what a very great deal of work has yet to be done before even an outline of the ethnological conditions can be mapped out. Apart from its scientific side the book is absorbingly interesting as a record of personal adventure and research in an unknown land. The record of the careful approach to completely savage tribes and the steps taken to gain their confidence is one of the most interesting features of a very remarkable book. We can unhesitatingly recommend it as one of the very best travel books we have read for a very long time.

The Story of Electricity. By W. F. F. SHEARCROFT, B.Sc., A.I.C. (Ernest Benn). (2*s.* 6*d.* paper and 3*s.* 6*d.* cloth).

The pressure of modern ideas of atomic structure has profoundly modified not only chemical but physical theory. The teacher finds that the standard textbook or classbook is evasive or non-committal, but that the students press for a clearer statement of the present line of thought in regard to fundamental conceptions. The true nature of electricity is still a mystery, but Dr. Shearcroft's little book gives a clear concise story of how bit by bit man has gained fresh insight and slowly marshalled fact into line with theory. The author traces the developments and devotes adequate space to a clear review of modern ideas down to the Quantum theory and a short sketch of relativity. Finality is not reached, but a good picture is drawn of the trend of modern thought. Both teachers and students will find the work extremely useful in conveying a general outline of the position as we know it to-day.

Elements of Physical Biology. By ALFRED LOTKA, M.A., D.Sc. (Bailliere, Tindall & Cox, English Agents, 25*s.* net. $5 post paid).

This book deals with the physical aspect of biology and introduces the reader into all the intricate mathematical and physical methods by which large general problems may be solved. Plato is aptly quoted by the author at the head of Chapter VII. "If arithmetic, mensuration and weighing be taken away from any art, that which remains will not be much." Here we have the keynote of the work, throughout which it is shown how to apply broadly physical principles and methods to the study of biological systems.

Many biologists tend to show a contempt for mathematical treatment in biology; a contempt based on misunderstanding. On the other hand there is an ever growing section which flies to mathematics on the least provocation without bearing in mind all the implications of the methods used. This volume is an admirable corrective for either attitude. It explains the principle underlying the mathematical treatment and points out the philosophical significance of the deductions.

To the pure biologist, as well as to those who deal chiefly with the statistical and mathematical side, the problems are intensely interesting, out of which arise new methods of attack directly or indirectly of economic importance. We are already familiar with many of these methods which, although perhaps not in sufficiently general use, still are much valued by those who understand, and this book abounds with suggestions and improvements on old ideas, and there are many interesting diagrams and tables illustrating the scope of such work. The author has thus produced a systematic and organized survey of this very recent branch of science to which he gives the name *Physical Biology*, dealing chiefly with the living organism and its relations to environment. "Elements of Physical Biology" is perhaps too inclusive a title. One would expect a more detailed treatment concerning the relation between physical phenomena and biology.

There is little in the living world which cannot offer an opportunity for study in this way, and surprising are the results produced. To take but one instance from the mechanical side in the feeding of predatory organisms, a subject usually treated purely biologically. It is here shown, if certain reasonable assumptions are made, that the smaller the organism the greater is its chance of capturing food. All the problems of food chains are splendid subjects for statistical study, and this is emphasized amongst many suggested points of attack.

There is much of a purely philosophical nature here also, and the volume abounds in apt quotations from an enormous army of philosophers, mathematicians, physicists, biologists, in fact, representatives of all those branches of science which together offer a huge field in which one may find subjects for the study of physical biology.

The English agents for this book are Messrs. Bailliere, Tindall & Cox, 8, Henrietta Street, Covent Garden.

Aspects of Science. H. SPENCER TOY, B.Sc. (Dranes. 6*s.* net)

The author republishes in book form ten articles on popular scientific subjects, one or two of which are reprinted from DISCOVERY.

University of Liverpool Annals of Archaeology and Anthropology. Vol. XI, Parts 3 and 4. 1924. (6s. net).

A periodical which covers so wide a field as the *Liverpool Annals*, yet in these days of expensive production is strictly limited in size, necessarily suffers in that each number must, as a rule, appeal only to a more or less limited public. The editor, wisely, however, has not succumbed to what must have been a great temptation, and varied the contents of each number at the expense of the length of the contributions and to the detriment of thoroughness in treatment. A case in point is the account of the Oxford excavations in Nubia by Mr. G. Ll. Griffiths, of which one instalment appears in the first of the two parts under review, and a second occupies nearly the whole of Part 4. It gives a detailed description of the finds figured in the fifty-nine plates in the latter, and thus provides material which is invaluable in elucidating the culture of that area in the " Meroitic " period of which the political history has been worked out in outline by Dr. G. A. Reisner, whose own excavations in Nubia have brought to light evidence of crucial importance in the history of early Egypt. The excavations of which the results are here described by Mr. Griffiths were carried out by Dr. Blackman in 1910-1911 and by Mr. C. Leonard Woolley in the following season. In the two years over two thousand graves were examined. They ranged in date from late Ptolemaic times in the last century B.C. to about 550 A.D., though few were found of a date later than the second century A.D. Unfortunately, all the graves appear to have been plundered in antiquity and the dampness and salinity of the site owing to irrigation and the Nile soakage have destroyed all perishable objects, as well as the iron and even some of the glass. Yet sufficient material has been recovered to throw light upon the cultures which met in the Nubian area and to support Dr. Reisner's views of the swaying to and fro of power there during and after the reign of the Ptolemys in Egypt. Part 3, in addition to the preliminary account of the Nubian excavations, contains a contribution by Mr. Sidney Smith—" The Face of Humbaba "—on a grotesque Assyrian face in clay of peculiar technique which throws a curious light on some of the religious beliefs and ritual of early Mesopotamia. Although the face is undoubtedly of Assyrian date, say the seventh century B.C., it appears to be a copy derived from the times of Sargon of Agade, who reigned about 2700. B.C. The outlines of the grotesque face are indicated by a single twined roll of clay on a concave surface. This peculiar technique, the author holds, explains the cryptic formula, " If the entrails are like the face of Humbaba a rebel will rule all the land," given in the cuneiform tablets of divination by inspection of the entrails.

Bacteriology. By CARL H. BROWNING, Home University Library. (Williams & Norgate. 2s. 6d. net).

The ordinary textbook of bacteriology or microbiology is too specialized to entertain the general reader. This volume, written in a series admittedly for the general reader, therefore fills a particular gap and fills it extremely well. To a certain extent it presupposes knowledge on the part of the reader, but it treats him kindly and does not exact too much. The book gives a very complete summary of bacteriological work as we know it to-day, and does not confine its scope to purely pathogenic organisms. It is valuable to the student as well as to the general reader, for it gives a good general summary of many facts which lecturers wrongly suppose are already known to the student. Many university men will find reading it a valuable prelude to the standard course, for it surveys the subject in general and affords an excellent perspective. There are one or two minor points where the book might be improved. The list of books to be consulted might be considerably extended and more detailed references given, and the American system of including a short glossary of the meaning of technical and scientific terms might well be adopted. The layman finds that although the explanation of a term may be given in an earlier chapter, it is convenient to have a glossary for quick reference, as it is not always easy to retrace the original passage. Confusion of thought is all too easy when a series of new unfamiliar words have to be mastered. The author deserves great credit for the way in which he has simplified an astonishingly technical subject, and the book is a very valuable addition to the modern general knowledge shelf of the non-specialist.

A. McC.

Proteus, or the Future of Intelligence. By VERNON LEE. (Kegan Paul. 2s. 6d.).

Another of the " To-day and Tomorrow " series—and a very stimulating little essay. Miss Vernon has much in common with the earlier writers in this series, notably Mr. Bertrand Russell, who put forward the Bloomsbury point of view. She interprets intelligence as a highbrow dilletantism, which, in her opinion, is more likely to obtain a glimpse of truth than either genius or single-minded research. Like others of her kind, Miss Lee has a sentimental attachment for the 18th century and for a cultured classicism. Her outlook seems to savour more of a weak discontent with the bustle of progress or of an apology for self-conscious aestheticism than of a valuable contribution to the thought of " to-day and to-morrow."

J. M. C.

The Lake Villages of Somerset. By ARTHUR BULLEID, L.R.C.P., F.S.A. (Folk Press Ltd. 2s. net).

No archaeological researches abroad can compare in interest with the very natural enthusiasm we have for the record of our own country. These lake villages at Mere, near Glastonbury, are absorbingly interesting. Mr. Bulleid's book gives one a clear picture of the life of the early ancestors, and a very good idea of the years of careful work which go to the clearing up of an important archaeological site.

The record of objects found and the elucidation of their use is singularly clear. The mystery of the fate that overwhelmed the village is not solved but left until further work clears up the problem. The book is strongly recommended to all those who are interested in archaeological research in Britain.

The Conquest of Cancer. By H. W. S. WRIGHT, M.S., F.R.C.S. (Kegan Paul. 2s. 6d. net).

Here is a little book which has been needed for a long time. Cancer has become a greater danger because of the fear that it inspires. Sensational press stunts have not made for a better understanding of the problem, but have led people to shrink from facing a secret fear—until it was too late.

Mr. Wright's sound, sensible, and comforting little book gives the plain facts so far as they are known to medical men at present. Taken in time cancer is curable. In general, the book is a plea for better public understanding, for a wider appreciation of the early pre-cancerous stages which are simply and easily operable.

Books are written by the million, but it is not one in a million which will save life and alleviate mental and physical suffering. This is one of the rare ones which will. It deals with facts as they are, not with misty futures, and tells the individual what he should do, here and now, in order to find safety.

The Mechanical Investigations of Leonardo da Vinci. By IVOR B. HART. (Chapman & Hall. 16*s.* net).

Leonardo da Vinci's notebooks represent a quarry of important material all too neglected by English writers. The author, however, treats only certain sections, notably those on Dynamics, Statics and Aviation, with particular reference to the M.S. on the Flight of Birds.

It is a matter for regret that other sections which might well come under the same title are not included. Leonardo's engines of warfare were of exceptional interest, and it would appear that some of the movements he applied in his aviation experiments could only have been found in the war engines figured in Valturius and earlier M.S.

The outstanding impression given by the book is that Leonardo was not only an extremely acute observer, but that he was very definitely a pioneer of the scientific method of adjusting phenomena perceived into definite laws or relationships. The book may therefore be taken rather as a study of one particular facet of the astonishingly many-sided genius of Leonardo da Vinci. He brought his study of flight astonishingly close to accepted modern theory and practice. It was an outstanding interest, and it is more than possible that other studies, in particular those on anatomy, may have been influenced by the dominant interest in the possibility of human flight.

The book serves to whet one's appetite for a fuller appreciation and general study of Leonardo da Vinci's attainments in the science of his time, and it is to be hoped that the author will follow it up with others with equally precise studies of other sections of the notebooks.

Rejuvenation by Grafting. By DR. SERGE VORONOFF. (George Allen & Unwin. 15*s.* net).

This is the English translation of Professor Voronoff's remarkable work on forty-three cases of grafts of monkey-glands to man. It is an essentially medical book, neither meant for nor suitable for general reading, but it is of considerable interest to scientific workers whose interests are biological rather than medical. Professor Voronoff writes fascinatingly of the development of his idea, his early experiments on goats, and his reasons for selecting the anthropoidape. The record of these experiments is in some instances as interesting as the detailed record of the formal cases. Heterografts between animals of different species failed, but grafts between animals of allied species—which the author distinguishes under the name of "homeografts" to prevent confusion with true homografts between animals of the same species, were within limits successful.

The function of gland grafting does not necessarily involve a revival of sexual efficiency, although this effect has been associated with many of the successful cases. This factor may be of great importance in veterinary practice, but so far as man is concerned it is the general improvement in physical and mental health which represents the most important result of the operation. A secondary field of research is indicated in the account of the extraordinary healing value exerted on ordinary wounds by the application of a pulp made of the glands.

The duration of life of Voronoff's results has not yet been determined. In some cases it has endured for several years since the operation, but it seems probable that it is a slowly vanishing effect which may call for a repetition of the operation after a lapse of years.

Chemistry in the Service of Man. By ALEXANDER FINDLAY, M.A., D.Sc. (Longmans, Green & Co. 6*s.*).

The publication of the third edition of this book, based originally on a course of lectures delivered in Aberdeen during the war, is not surprising, because it is clearly one of those books that appeal to the general reader. The author has not been content merely to communicate to his readers information of a technical kind, or to prove how very necessary such knowledge is for our well-being; he has shown also how interesting and educative the subject may be for its own sake. Following the introductory chapter is a clear and up-to-date account of atomic structure and of radio-activity, which, in spite of the difficulties of the subject, is not difficult to follow. The rare gases of the atmosphere are next described. These were once of little use to the practical man, but new uses for them are constantly being found, and their discovery has led to so many interesting developments of a theoretical kind that one sometimes wonders where at present we should be, had their discovery been overlooked. The fourth chapter deals with combustion and the production of fire, the fifth with illuminants, and the sixth with fuel and explosives. These are subjects which touch each one of us in our home life and an account of them serves as a basis for understanding such problems as the "Smoke Problem," the best way of lighting one's house or of heating it. The next chapter deals with cellulose and its products, and gives an account of the infant industry of artificial silk-making which is likely in the future to be a very large one. Later chapters consider the manufacture of ammonia, nitric acid, and fertilizers from the gases in our atmosphere, the softening of water for washing purposes, the cause and nature of fermentation, and the manufacture of dyes.

Altogether it is a very readable book, accurate and informed, At the same time, although matters of theory are rightly discussed. the reader is not wearied by technicalities or bored by matters that pertain to the rarefied air of theory and hypothesis.

Louis Pasteur. By S. J. HOLMES, Ph.D. (Chapman & Hall. 7*s.* 6*d.* net).

It is not often that we have had the pleasure of reading a simplified biography which is as good as this little book. It is as interesting as a novel, and a very perfect model of what such a book should be. The main lines of Pasteur's work, first as a chemist, then as a microscopist developing into a bacteriologist, are accurately traced, showing precisely the habit of reasoning which led Pasteur to his conclusions. The book covers in its general scope a very good summary of the mid-nineteenth century controversies over spontaneous generation and the birth of the antiseptic theory. This is useful, for in these days of the complexities of specialized science the early steps by which our present conclusions have been reached are often all too cavalierly dismissed. We can very heartily recommend this book not only as a little study of the character and victories of the great Louis Pasteur, but as an introduction to the study of scientific thinking. It is good for general reading, and is particularly appropriate as a gift to any youth about to begin his studies for a scientific career.

Elementary Crystallography. By J. W. EVANS, D.Sc., F.R.S., F.G.S., and GEORGE M. DAVIES, M.Sc., F.G.S. (Thos. Murby. 9*s.* 6*d.* net).

Crystallography is a subject of increasing importance in view of recent research on molecular and atomic structure. In the past it has been perhaps part of the peculiar domain of the mineralogist, but to-day it enters into the work of both chemist and physicist. The work covers the main crystal systems, and has a valuable feature in the addition of a short course of practical work to each chapter. It is suitable for class instruction for the Intermediate.